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ALDEHYDE AND REACTIVE ORGANIC EMISSIONS FROM MOTOR VEHICLES. PART II. CHARACTERIZATION OF EMISSIONS FROM 1970 THROUGH 1973 MODEL VEHICLES

Bureau of Mines
Bartlesville, Oklahoma

March 1973

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Part II
Characterization of Emissions from 1970 through 1973 Model Vehicles
Final Report

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U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
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Aldehyde and reactive organic emissions as well as carbon monoxide and oxides of nitrogen emissions were measured from 1970 through 1973 model vehicles. The aim was to characterize such emissions and to provide data to compare exhaust hydrocarbon reactivity for exhaust from 1970 through 1973 vehicles with that of exhaust from prototype low-emission systems.

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Bartlesville, Oklahoma

Interagency Agreement Number MSPCP-IAG-001

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Prepared for

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FOREWORD

This report presents a summary of work performed by the Fuels Combustion Research Group, Bartlesville Energy Research Center, Bureau of Mines, for the Environmental Protection Agency (EPA), Office of Air and Water Programs, Office of Mobile Source Air Pollution Control, Emission Control Technology Division, Emission Characterization and Control Development Branch under Interagency agreement number MSPCP-IAG-001. This work was an extension of a program which was done under Interagency Agreement EPA-IAG-0188(D) (part I of this report).

The program at Bartlesville was directed by R. W. Hurn, Research Supervisor; Dr. R. D. Fleming, Project Leader was responsible for the experimental work. Others who contributed to the experimental work were: R. D. Lawrence, Mechanical Engineer; T. R. French, Research Chemist; and R. D. Tate, J. L. Bennett, Jr., and D. R. Thompson as Mechanical Engineering Technicians. C. J. Raible, Research Physicist; Sammy Montee, Physical Sciences Aide; and L. E. Nichols, Jr., Mechanical Engineering Technician, assisted in the chromatographic analysis of hydrocarbons. J. M. Clingenpeel, Chemical Engineer; Carol Wilson, Research Chemist; and R. F. Stevens, Mechanical Engineering Technician, assisted in aldehyde measurements. Harrison W. Sigworth, Jr., was the Project Officer for EPA.

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PART II. -- CHARACTERIZATION OF MOTOR VEHICLE ALDEHYDE AND REACTIVE ORGANIC EMISSIONS FROM 1970 THROUGH 1973 MODEL VEHICLES

I. SUBJECT

This report covers results from experimental work in measurement of aldehyde and reactive organic emissions as well as carbon monoxide and oxides of nitrogen emissions from 1970 through 1973 model vehicles.

II. OBJECTIVE

The objective of the study was to characterize aldehyde and reactive organic emissions from 1970 through 1973 model vehicles and to provide data to compare exhaust hydrocarbon reactivity for exhaust from 1970 through 1973 vehicles with that of exhaust from prototype low-emission systems (data obtained from a previous program that was done under Interagency Agreement No. EPA-IAG-0188(D) and reported in part I of this report).

III. SUMMARY AND CONCLUSIONS

Engineering data were obtained on the emission characteristics of ten production vehicles using the 1975 Federal test procedure (FTP). Exhaust hydrocarbon reactivities were calculated from data for the ten vehicles used in this program and compared with reactivities calculated from data (reported in part I of this report) for prototype low-emission systems.

The following are observations and/or conclusions based on the results from the experimental program.

1. Carbon monoxide (CO) emission from the ten vehicles ranged from 11 to 60 g/mile when using a 40 pct aromatic fuel. The average CO emission of the ten vehicles was about 13 pct higher when a 22 pct aromatic fuel was used in place of the 40 pct aromatic fuel. This fuel effect on CO emission is probably caused by changes in fuel physical properties (primarily fuel density) which affects carburetor metering characteristics and thus affecting air-fuel ratio.

2. Hydrocarbon (HC) emission from the ten vehicles ranged from 1.8 to 5.9 g/mile when a 40 pct aromatic fuel was used. The average HC emission was not significantly different for the 22 pct and 40 pct aromatic fuels.

3. Oxides of nitrogen (NO_x) emission for the ten vehicles ranged from 1.9 to 9.4 g/mile when a 40 pct aromatic fuel was used. The average NO_x emission was about 8.7 pct higher for the 40 pct aromatic fuel when compared to the 22 pct aromatic fuel.

4. Aldehyde emission by the 3-methyl-2-benzothiazolone hydrazone hydrochloride (MBTH) method for the ten vehicles was from 0.07 to 0.3 g/mile. Aldehyde emission was from 2 to 9 pct of the total organic emissions.

5. Aldehyde emission as measured by the 2,4-dinitrophenylhydrazone (DNPH) method averaged about 28 pct higher than that measured by the MBTH method when considering all ten vehicles and the two fuels.

6. For the 1970-1973 production vehicles, molar HC reactivity for exhaust from the 40 pct aromatic fuel averaged about 3 pct higher than that for a 22 pct aromatic fuel.

7. The molar HC reactivity of exhaust from thermal reactor and oxidation catalyst vehicles was about 25 pct lower than that for 1970-1973 production vehicles.

8. The molar HC reactivity of exhaust from the dual catalyst vehicle (used in the study reported in part I of this report) was about 50 pct lower than that for thermal reactor and oxidation catalyst vehicles.

IV. DESCRIPTION OF VEHICLES AND FUELS

A. Vehicles

The following is a description of the ten production vehicles used in the test program:

1. Car No. 151 - A 1972 Oldsmobile 98 (17,876 miles) with a 455-CID engine and 4-barrel carburetor.

2. Car No. 707 - A 1971 Ford Galaxie (25,271 miles) with a 351-CID engine and 2-barrel carburetor.

3. Car No. 76 - A 1971 Plymouth Fury III (23,313 miles) with a 360-CID engine and 2-barrel carburetor.

4. Car No. 769 - A 1972 Ford Torino (17,080 miles) with a 351-CID engine and 2-barrel carburetor.

5. Car No. 595 - A 1970 Chevrolet Impala (38,402 miles) with a 350-CID engine and 2-barrel carburetor.

6. Car No. 400 - A 1970 Pontiac (68,779 miles) with a 400-CID engine and 2-barrel carburetor.

7. Car No. 365 - A 1970 Volkswagon (11,610 miles) with a 1,600cc engine and single-barrel carburetor.

8. Car No. 68 - A 1971 Chevrolet Vega (42,390 miles) with a 2,300cc engine and single-barrel carburetor.

9. Car No. 146 - A 1973 Ford Torino (2,288 miles) with a 351-CID engine and 2-barrel carburetor.

10. Car No. 110 - A 1973 Chevrolet Impala (2,544 miles) with a 350-CID engine and 2-barrel carburetor.

All the vehicles were equipped with automatic transmissions with the exception of the 1970 Volkswagon (car 365) and the 1971 Chevrolet Vega (car 68) which were equipped with 4-speed and 3-speed manual transmissions, respectively.

The first five vehicles were selected to have engine/transmission/rear axle combinations which matched those of the six vehicles equipped with prototype emission control systems used in the previous work done under Interagency agreement EPA-IAG-0188(D) (part I of this report). The other five vehicles were selected to represent popular 1970-1973 vehicles.

B. Fuels

Two fuels were used in the program: (1) a 40 pct aromatic fuel (typical clear II, No. 7221) and (2) a 22 pct aromatic fuel (Indolene clear, No. 7203).

Fuel inspection data for these two fuels can be found in part I of this report describing the work done under Interagency agreement EPA-IAG-0188(D).

V. DESCRIPTION OF THE EXPERIMENTAL PROGRAM

The experimental program consisted of running two replicate tests in accordance with the 1975 (three-bag) FTP using the ten vehicles and two fuels described above. All tests were conducted at 75° F ambient temperature. The mass emissions measured were: CO, total HC, NO_x, and total aldehydes by the MBTH method. The exhausts were also chromatographically analyzed for the various hydrocarbons. Additionally, aldehyde emission was measured by the DNPH method (samples of exhaust were collected in accordance with the 1972 FTP).

VI. EXPERIMENTAL PROCEDURES

A. Test Procedures, Exhaust Sampling, and Analysis

Test procedures, exhaust sampling, and analysis was the same as those used in the previous program and are described in part I of this report. Prior to vehicle testing, each vehicle was checked and, if necessary, adjustments were made to bring engine adjustment parameters within the manufacturers' specifications.

B. Calculating Hydrocarbon Reactivity

Exhaust hydrocarbon reactivities were calculated from results of the chromatographic analysis by two methods: (1) A reactivity scale proposed by Altshuller (1)[1/] and designated HEW reactivity and (2) a reactivity scale proposed by Jackson (2) and designated GM reactivity.

Before the reactivities were calculated, appropriate corrections were made to the chromatographic data to account for HC in the diluent air supplied to the constant volume sampler.

1/ Underlined numbers in parentheses refer to the list of references at the end of this report.

Reactivities are expressed both on the basis of molar reactivity (reactivity per mole of hydrocarbon) and mass reactivity (reactivity per gram of hydrocarbon).

Comparable reactivities for the program using vehicles equipped with prototype emission control systems (part I of this report) were calculated and are presented in this section of the report.

VII. EXPERIMENTAL RESULTS

A. Mass Emissions

Mass emission data from the ten vehicles are summarized in table 1. Data for individual bags and the individual replicate tests are in Appendix A.

Carbon monoxide emission ranged from a low of 10.9 g/mile for car 151 to a high of 59.8 g/mile for car 707 for the 40 pct aromatic fuel. For seven of the ten vehicles, CO was from 6 to 56 pct higher for the 22 pct aromatic fuel than for the 40 pct aromatic fuel. The other three vehicles emitted from 2 to 15 pct lower CO for the 22 pct aromatic fuel than for the 40 pct aromatic fuel.

Hydrocarbon emissions varied from 1.79 g/mile for car 151 to 5.86 g/mile for car 400 when using the 40 pct aromatic fuel. The HC emission was from 1 to 14 pct higher for six of the ten cars with the 22 pct aromatic fuel when compared with the 40 pct aromatic fuel. The HC emission from the other four vehicles was from 2 to 22 pct lower for the 22 pct aromatic fuel when compared with the 40 pct aromatic fuel.

The effect of fuel composition on CO and HC emission is believed to be primarily caused by changes in fuel physical properties which affects carburetor metering (and thus affecting air-fuel ratio) rather than due to changes in the chemical composition, per se. That is, if each car's carburetor was adjusted for each fuel, there would probably not be a significant fuel effect with respect to CO and HC emissions.

With respect to NO_x emissions, nine of the ten vehicles showed that NO_x emissions were higher for the 40 pct aromatic

TABLE 1. - Summary data on influence of fuel composition on mass emissions [data are weighted in accordance with the 1975 Federal test procedure] from 1970-1973 test vehicles 1/

Fuel	Emissions, grams/mile			
	Carbon monoxide	Hydrocarbon	Nitrogen oxides 2/	Aldehydes (MBTH)
1972 OLDSMOBILE 98 (CAR 151) WITH A 455-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)..	10.9	1.79	5.01	0.13
Indolene clear, 22 percent aromatic (7203)..	14.6	1.72	4.70	.12
1971 FORD GALAXIE (CAR 707) WITH A 351-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)..	59.8	4.88	7.34	0.14
Indolene clear, 22 percent aromatic (7203)..	63.4	5.56	6.62	.15
1971 PLYMOUTH FURY III (CAR 76) WITH A 360-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)..	30.1	3.22	8.52	0.17
Indolene clear, 22 percent aromatic (7203)..	47.0	3.54	7.71	.14
1972 FORD TORINO (CAR 769) WITH A 351-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)..	38.0	2.16	4.32	0.076
Indolene clear, 22 percent aromatic (7203)..	42.4	2.29	3.70	.078
1970 CHEVROLET IMPALA (CAR 595) WITH A 350-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)..	51.2	3.58	4.37	0.14
Indolene clear, 22 percent aromatic (7203)..	68.2	3.94	3.80	.13

See footnotes at end of table.

TABLE 1. - Summary data on influence of fuel composition on mass emissions [data are weighted in accordance with the 1975 Federal test procedure] from 1970-1973 test vehicles 1/—Continued

Fuel	Emissions, grams/mile			
	Carbon monoxide	Hydrocarbon	Nitrogen oxides 2/	Aldehydes (MBTH)
1970 PONTIAC (CAR 400) WITH A 400-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)..	36.9	5.86	9.36	0.26
Indolene clear, 22 percent aromatic (7203)..	39.4	5.92	9.04	.28
1970 VOLKSWAGON (CAR 365) WITH a 1,600-CC ENGINE				
Typical clear II, 40 percent aromatic (7221)..	31.7	2.44	6.09	0.070
Indolene clear, 22 percent aromatic (7203)..	27.0	1.91	6.60	.082
1971 CHEVROLET VEGA (CAR 68) WITH A 2,300-CC ENGINE				
Typical clear II, 40 percent aromatic (7221)..	56.8	4.92	1.88	0.079
Indolene clear, 22 percent aromatic (7203)..	62.0	5.44	1.68	.088
1973 FORD TORINO (CAR 146) WITH A 351-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)..	21.0	2.79	4.17	0.15
Indolene clear, 22 percent aromatic (7203)..	19.6	2.68	3.87	.16
1973 CHEVROLET IMPALA (CAR 110) WITH A 350-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)..	33.4	2.16	2.66	0.20
Indolene clear, 22 percent aromatic (7203)..	32.7	2.12	2.38	.18

1/All tests were conducted at 75° F ambient temperature.

2/NO_x data are corrected for humidity to 75 grains H_2O per lb of dry air.

fuel than for the 22 pct aromatic fuel. Oxides of nitrogen emissions varied from 1.88 g/mile for car 68 to 9.36 g/mile for car 400 when using the 40 pct aromatic fuel.

Aldehyde emissions ranged from 0.070 g/mile for car 365 to 0.28 g/mile for car 400. Fuel composition had no significant effect on aldehyde emissions (MBTH). The aldehydes for the 1970-1973 vehicles were from 1.6 to 9.2 pct of the total organic emissions. The aldehydes for the prototype low-emission systems (reported in part I of this report were from 2.6 to 9.7 pct of the total organic emissions.

Based on the 1972 Federal test procedure, the aldehydes by the DNPH method were from 6 to 69 pct higher than aldehydes measured by the MBTH method (table 2). Considering all ten vehicles and the two fuels, aldehydes by the DNPH method averaged about 28 pct higher than that measured by the MBTH method.

B. Hydrocarbon Distribution

Hydrocarbon distributions for the ten vehicles are summarized in table 3. The complete set of data are given in appendix B.

The weight fraction of methane in the exhaust was consistently higher for the 22 pct aromatic fuel than that for the 40 pct aromatic fuel for all the vehicles tested. The methane in the exhaust ranged from 3 to 11 pct of the total HC for the typical clear fuel (40 pct aromatic).

The weight fraction of C_3-C_6 olefins in the exhaust was in all cases significantly higher for the 22 pct aromatic fuel than that for the 40 pct aromatic fuel. The reverse was noted for C_{7+} aromatics. It appeared that the exhaust aromatics increased approximately in direct proportion to the fuel aromatics for all ten vehicles.

C. Exhaust Hydrocarbon Reactivity

Exhaust HC reactivities were calculated based both on the HEW and GM scales. Data are summarized in table 4 for the ten vehicles and comparable reactivity data for prototype low-emission systems (calculated from data of part I of this report) are summarized in table 5. The reactivity data are expressed on the basis of reactivity per mole of HC and reactivity per gram of HC.

TABLE 2. - Summary data on comparison of MBTH and DNPH methods for aldehyde measurements [Data are expressed as grams/mile on the basis of the 1972 Federal test procedure] 1/

Fuel	MBTH	DNPH	MBTH	DNPH
	1972 OLDS 98 (CAR 151) - 455 CID		1970 VOLKSWAGON (CAR 365) - 1,600 CC	
Typical clear II, 40 percent aromatic (7221)	0.13	0.17	0.071	0.12
Indolene clear, 22 percent aromatic (7203)	.12	.18	.082	.096
	1971 FORD GALAXIE (CAR 707) - 351 CID		1971 PLYMOUTH FURY III (CAR 76) - 360 CID	
Typical clear II, 40 percent aromatic (7221)	0.14	0.20	0.18	0.22
Indolene clear, 22 percent aromatic (7203)	.16	.17	.14	.18
	1972 FORD TORINO (CAR 769) - 351 CID		1970 CHEVROLET IMPALA (CAR 595) - 350 CID	
Typical clear II, 40 percent aromatic (7221)	0.082	0.11	0.14	0.16
Indolene clear, 22 percent aromatic (7203)	.082	.10	.13	.15
	1970 PONTIAC (CAR 400) - 400 CID		1971 CHEVROLET VEGA (CAR 68) - 2,300 CC	
Typical clear II, 40 percent aromatic (7221)	0.24	0.38	0.083	0.098
Indolene clear, 22 percent aromatic (7203)	.26	.33	.098	.12
	1973 FORD TORINO (CAR 146) - 351 CID		1973 CHEVROLET IMPALA (CAR 110) - 350 CID	
Typical clear II, 40 percent aromatic (7221)	0.16	0.18	0.20	0.28
Indolene clear, 22 percent aromatic (7203)	.15	.18	.18	.24

1/ All tests were conducted at 75° F ambient temperature.

TABLE 3. - Summary data on influence of fuel composition on hydrocarbon distribution in exhaust [data are weighted in accordance with the 1975 Federal test procedure] from 1970-1973 test vehicles 1/

Fuel	Total HC, grams/mile	Hydrocarbon distribution, weight percent								
		Paraffins			Olefins			Aromatics		Acetylenes
		Methane	C_2-C_5	C_6+	Ethylene	C_3-C_5	C_6+	Benzene	C_7+	
1972 OLDSMOBILE 98 (CAR 151) WITH A 455-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)..	1.79	3.0	8.8	17.4	9.6	9.0	2.1	4.5	39.4	6.2
Indolene clear, 22 percent aromatic (7203)..	1.72	5.3	10.2	21.0	14.0	16.6	1.9	4.2	18.1	8.7
1971 FORD GALAXIE (CAR 707) WITH A 351-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)..	4.88	8.7	7.4	12.6	8.4	9.6	1.5	4.8	35.2	11.8
Indolene clear, 22 percent aromatic (7203)..	5.56	11.4	7.8	20.0	9.8	12.8	2.0	3.8	18.2	14.2
1971 PLYMOUTH FURY III (CAR 76) WITH A 360-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)..	3.22	3.6	8.3	12.5	10.6	12.7	1.2	5.1	40.1	5.9
Indolene clear, 22 percent aromatic (7203)..	3.54	6.1	8.9	19.6	12.9	18.5	1.7	4.2	21.4	6.7
1972 FORD TORINO (CAR 769) WITH A 351-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)..	2.16	10.9	7.7	8.9	10.8	8.4	0.8	6.0	31.2	15.3
Indolene clear, 22 percent aromatic (7203)..	2.29	12.6	8.2	14.1	13.5	13.0	1.1	4.5	16.2	16.8
1970 CHEVROLET IMPALA (CAR 595) WITH A 350-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)..	3.58	6.3	7.0	11.4	10.0	10.4	1.1	5.5	40.6	7.7
Indolene clear, 22 percent aromatic (7203)..	3.94	9.1	7.5	17.9	13.0	15.8	1.6	4.3	21.3	9.5
1970 PONTIAC (CAR 400) WITH A 400-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)..	5.86	3.7	10.1	21.7	8.0	12.8	3.1	3.9	31.7	5.0
Indolene clear, 22 percent aromatic (7203)..	5.92	5.2	10.5	25.0	9.9	16.3	2.9	3.5	19.7	7.0
1970 VOLKSWAGON (CAR 365) WITH A 1,600-CC ENGINE										
Typical clear II, 40 percent aromatic (7221)..	2.44	6.6	7.3	12.8	9.4	8.6	1.1	5.2	39.8	9.2
Indolene clear, 22 percent aromatic (7203)..	1.91	8.1	9.0	18.2	12.3	15.7	1.4	4.3	20.6	9.8

See footnotes at end of table.

TABLE 3. - Summary data on influence of fuel composition on hydrocarbon distribution in exhaust [data are weighted in accordance with the 1975 Federal test procedure] from 1970-1973 test vehicles 1/—Continued

Fuel	Total HC, grams/mile	Hydrocarbon distribution, weight percent								
		Paraffins			Olefins			Aromatics		Acetylenes
		Methane	C_2-C_5	C_6+	Ethylene	C_3-C_5	C_6+	Benzene	C_7+	
1971 CHEVROLET VEGA (CAR 68) WITH A 2,300-CC ENGINE										
Typical clear II, 40 percent aromatic (7221)..	4.92	7.4	9.4	19.9	7.9	8.8	2.8	3.8	30.9	9.1
Indolene clear, 22 percent aromatic (7203)..	5.44	8.8	9.5	27.4	8.8	10.7	2.8	3.4	18.5	10.1
1973 FORD TORINO (CAR 146) WITH A 351-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)..	2.79	4.7	8.1	11.5	11.0	13.1	1.2	5.3	38.5	6.6
Indolene clear, 22 percent aromatic (7203)..	2.68	5.6	9.0	16.7	14.4	21.4	1.4	4.2	19.9	7.4
1973 CHEVROLET IMPALA (CAR 110) WITH A 350-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)..	2.16	6.1	8.8	14.3	10.6	10.3	1.6	5.2	36.7	6.4
Indolene clear, 22 percent aromatic (7203)..	2.12	7.4	10.1	21.3	13.0	15.5	1.9	4.3	19.3	7.2

1/ All tests were conducted at 75° F ambient temperature.

TABLE 4. - Summary data on influence of fuel composition on exhaust hydrocarbon reactivity [data are weighted in accordance with the 1975 Federal test procedure] from 1970-1972 test vehicles 1/

Fuel	Total HC, grams/mile	Average molecular weight of HC	Hydrocarbon reactivity			
			Reactivity per mole of HC		Reactivity per gram of HC	
			HSW	GM	HSW	GM
1972 OLDSMOBILE 98 (CAR 151) WITH A 455-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)..	1.79	55.3	2.64	2.52	0.0476	0.0455
Indolene clear, 22 percent aromatic (7203)..	1.72	47.4	2.63	2.64	.0560	.0560
1971 FORD GALAXIE (CAR 707) WITH A 351-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)..	4.88	46.0	2.02	1.90	0.0438	0.0412
Indolene clear, 22 percent aromatic (7203)..	5.56	41.0	1.83	1.86	.0446	.0451
1971 PLYMOUTH FURY III (CAR 76) WITH A 360-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)..	3.22	54.0	2.88	2.66	0.0534	0.0492
Indolene clear, 22 percent aromatic (7203)..	3.54	47.3	2.77	2.72	.0586	.0574
1972 FORD TORINO (CAR 769) WITH A 351-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)..	2.16	40.6	1.75	1.58	0.0431	0.0390
Indolene clear, 22 percent aromatic (7203)..	2.29	37.2	1.78	1.70	.0480	.0458
1970 CHEVROLET IMPALA (CAR 595) WITH A 350-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)..	3.58	50.3	2.48	2.24	0.0492	0.0446
Indolene clear, 22 percent aromatic (7203)..	3.94	43.3	2.34	2.26	.0542	.0522
1970 PONTIAC (CAR 400) WITH A 400-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)..	5.86	57.8	2.80	2.88	0.0486	0.0500
Indolene clear, 22 percent aromatic (7203)..	5.92	51.0	2.64	2.79	.0518	.0547
1970 VOLKSWAGON (CAR 365) WITH A 1,600-CC ENGINE						
Typical clear II, 40 percent aromatic (7221)..	2.44	49.9	2.28	2.07	0.0456	0.0414
Indolene clear, 22 percent aromatic (7203)..	1.91	44.6	2.32	2.23	.0520	.0500

See footnotes at end of table.

TABLE 4. - Summary data on influence of fuel composition on exhaust hydrocarbon reactivity [data are weighted in accordance with the 1975 Federal test procedure] from 1970-1973 test vehicles 1/—Continued

Fuel	Total HC, grams/mile	Average molecular weight of HC	Hydrocarbon reactivity			
			Reactivity per mole of HC		Reactivity per gram of HC	
			HEW	GM	HEW	GM
1971 CHEVROLET VEGA (CAR 68) WITH A 2,300-CC ENGINE						
Typical clear II, 40 percent aromatic (7221)..	4.92	50.1	2.10	2.16	0.0420	0.0432
Indolene clear, 22 percent aromatic (7203)..	5.44	47.0	1.95	2.21	.0414	.0470
1973 FORD TORINO (CAR 146) WITH A 351-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)..	2.79	51.6	2.78	2.56	0.0537	0.0496
Indolene clear, 22 percent aromatic (7203)..	2.68	46.0	2.90	2.82	.0631	.0612
1973 CHEVROLET IMPALA (CAR 110) WITH A 350-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)..	2.16	50.8	2.49	2.34	0.0490	0.0460
Indolene clear, 22 percent aromatic (7203)..	2.12	46.2	2.48	2.60	.0536	.0562

1/ All tests were conducted at 75° F ambient temperature.

TABLE 5. - Summary data on influence of fuel composition on exhaust hydrocarbon reactivity [data are weighted in accordance with the 1975 Federal test procedure] from prototype low emission systems 1/

Fuel	Total HC, grams/mile	Average molecular weight of HC	Hydrocarbon reactivity			
			Reactivity per mole of HC		Reactivity per gram of HC	
			HEW	GM	HEW	GM
1972 OLDSMOBILE DELTA 88 (CAR 403) WITH A 455-CID ENGINE AND EQUIPPED WITH A BASE-METAL OXIDATION CATALYST AND EGR						
Typical clear I, 35 percent aromatic (7202)..	0.33	41.3	2.16	1.98	0.0525	0.0482
Indolene clear, 22 percent aromatic (7203)..	.43	39.1	1.94	1.81	.0496	.0461
1971 FORD LTD (CAR 810) WITH A 351-CID ENGINE AND EQUIPPED WITH ESSO RAM REACTORS AND EGR						
Typical clear I, 35 percent aromatic (7202)..	0.17	43.9	1.14	1.80	0.0276	0.0407
Indolene clear, 22 percent aromatic (7203)..	.11	42.1	1.73	1.89	.0412	.0447
1971 PLYMOUTH FURY III (CAR 333) WITH A 360-CID ENGINE AND EQUIPPED WITH PLATINUM OXIDATION CATALYSTS AND EGR						
Typical clear II, 40 percent aromatic (7221)..	0.40	38.0	1.56	1.52	0.0410	0.0399
Indolene clear, 22 percent aromatic (7203)..	.39	33.8	1.40	1.50	.0414	.0443
1972 FORD TORINO (CAR 724) WITH A 351-CID ENGINE AND EQUIPPED WITH PLATINUM OXIDATION CATALYSTS AND EGR						
Typical clear II, 40 percent aromatic (7221)..	0.72	42.4	1.49	1.57	0.0351	0.0370
Indolene clear, 22 percent aromatic (7203)..	.79	39.7	1.33	1.57	.0334	.0396
1971 PLYMOUTH FURY III (CAR 775) WITH A 360-CID ENGINE AND EQUIPPED WITH THE ETHYL LEAN REACTORS AND EGR						
Typical clear II, 40 percent aromatic (7221)..	0.43	47.7	2.10	2.24	0.0442	0.0470
Indolene clear, 22 percent aromatic (7203)..	.44	48.6	2.17	2.69	.0448	.0554
1970 CHEVROLET IMPALA (CAR 58) WITH A 350-CID ENGINE AND EQUIPPED WITH GEM MONEL NO_x REDUCTION CATALYSTS AND PLATINUM OXIDATION CATALYSTS						
Typical clear II, 40 percent aromatic (7221)..	0.30	30.1	0.857	0.906	0.0281	0.0298
Indolene clear, 22 percent aromatic (7203)..	.34	26.8	.712	.738	.0265	.0275

1/ All tests were conducted at 75° F ambient temperature.

The following discussion is based on data expressed in terms of the HEW reactivity scale (molar reactivity).

For the ten vehicles (table 4), HEW molar HC reactivity averaged about 2.8 pct higher for the 40 pct aromatic fuel when compared with the 22 pct aromatic fuel. For the prototype emission control systems (table 5), the HEW molar HC reactivity averaged about 9.1 pct higher for the 40 pct aromatic fuel when compared to the 22 pct aromatic fuel. (Results from car 810 were not used in the average because the reactivity values are probably not reliable because of the extremely low total HC values.)

It should be noted that for the low emission systems (table 5), the HC reactivity of exhaust from the dual catalyst system (car 58) was about 52 pct lower than for the other low-emission systems.

The HEW molar HC reactivity for the low emission system (not including the dual catalyst vehicle) averaged about 25 pct lower than that for the 1970 through 1973 vehicles.

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APPENDIX A -- DATA ON THE INFLUENCE OF FUEL COMPOSITION ON MASS EMISSIONS FROM 1970 THROUGH 1973 VEHICLES

TABLE A-1. - Mass emissions for individual bags of the 1975 Federal test procedure and individual replicate tests from 1970 to 1973 vehicles 1/

Fuel	Bag number	Emissions, grams/test			
		Carbon monoxide	Hydrocarbon	Nitrogen oxides 2/	Aldehydes (MBTH)
1972 OLDSMOBILE 98 (CAR 151) WITH A 455-CID ENGINE					
Typical clear II, 40 percent aromatic (7221)	1	113	7.41	21.2	0.43
		116	6.55	24.6	.37
		88.2	6.89	25.1	.44
	Avg..	106	6.95	23.6	.41
	2	18.5	7.91	14.2	0.61
		18.9	6.91	14.0	.49
		19.3	7.83	14.7	.57
	Avg..	18.9	7.55	14.3	.56
	3	39.0	5.37	21.6	0.35
		27.0	4.65	24.0	.40
		25.0	5.18	23.1	.40
	Avg..	30.3	5.07	22.9	.38
Indolene clear, 22 percent aromatic (7203)	1	168	8.39	20.6	0.40
		149	7.77	20.2	.46
	Avg..	158	8.08	20.4	.43
	2	22.3	8.20	13.6	0.51
		19.0	3.33	14.2	.46
	Avg..	20.6	5.76	13.9	.48
	3	35.7	7.19	22.6	0.43
		35.3	5.82	21.4	.43
	Avg..	35.5	6.50	22.0	.43
1971 FORD GALAXIE (CAR 707) WITH A 351-CID ENGINE					
Typical clear II, 40 percent aromatic (7221)	1	506	33.5	25.7	0.58
		610	43.8	25.9	.45
	Avg..	558	38.6	25.8	.52
	2	135	12.4	27.7	0.64
		155	13.8	26.8	.56
	Avg..	145	13.1	27.2	.60
	3	101	11.4	29.4	0.46
		123	12.6	29.3	.37
	Avg..	112	12.0	29.4	.42
Indolene clear, 22 percent aromatic (7203)	1	625	59.2	21.9	0.71
		518	41.8	25.1	.66
	Avg..	572	50.5	23.5	.68
	2	200	14.5	23.4	0.52
		127	12.2	25.0	.59
	Avg..	164	13.4	24.2	.56
	3	138	12.4	24.8	0.46
		96.0	11.1	29.1	.52
	Avg..	117	11.8	27.0	.49

See footnotes at end of table.

TABLE A-1. - Mass emissions for individual bags of the 1975 Federal test procedure and individual replicate tests from 1970 to 1973 vehicles 1/—Continued

Fuel	Bag number	Emissions, grams/test			
		Carbon monoxide	Hydrocarbon	Nitrogen oxides 2/	Aldehydes (MBTH)
1971 PLYMOUTH FURY III (CAR 76) WITH A 360-CID ENGINE					
Typical clear II, 40 percent aromatic (7221)	1	167	14.2	31.6	0.72
		158	13.8	32.5	.58
	Avg..	162	14.0	32.0	.65
	2	89.3	12.2	31.1	0.79
		100	12.4	31.6	.57
	Avg..	94.6	12.3	31.4	.68
	3	103	10.3	33.3	0.57
		112	10.4	33.0	.57
	Avg..	108	10.4	33.2	.57
Indolene clear, 22 percent aromatic (7203)	1	218	15.7	27.6	0.44
		217	14.6	31.3	.54
	Avg..	218	15.2	29.4	.49
	2	163	13.3	26.4	0.44
		199	14.3	29.2	.62
	Avg..	181	13.8	27.8	.53
	3	132	10.9	27.5	0.62
		139	11.1	33.4	.53
	Avg..	136	11.0	30.4	.58
1972 FORD TORINO (CAR 769) WITH A 351-CID ENGINE					
Typical clear II, 40 percent aromatic (7221)	1	356	17.6	16.5	0.32
		411	18.3	17.0	.28
	Avg..	384	18.0	16.8	.30
	2	71.1	4.78	15.4	0.32
		77.9	4.93	15.9	.31
	Avg..	74.5	4.86	15.6	.32
	3	73.5	5.73	16.4	0.23
		84.7	6.87	16.9	.20
	Avg..	79.1	6.30	16.6	.22
Indolene clear, 22 percent aromatic (7203)	1	408	19.9	14.1	0.31
		348	14.6	15.0	.28
	Avg..	378	17.2	14.6	.30
	2	132	6.34	13.0	0.30
		74.9	4.96	12.7	.34
	Avg..	103	5.65	12.8	.32
	3	110	7.59	15.4	0.21
		71.0	6.90	14.8	.26
	Avg..	90.5	7.24	15.1	.24

See footnotes at end of table.

TABLE A-1. - Mass emissions for individual bags of the 1975 Federal test procedure and individual replicate tests from 1970 to 1973 vehicles 1/—Continued

Fuel	Bag number	Emissions, grams/test			
		Carbon monoxide	Hydrocarbon	Nitrogen oxides 2/	Aldehydes (MBTH)
1970 CHEVROLET IMPALA (CAR 595) WITH A 350-CID ENGINE					
Typical clear II, 40 percent aromatic (7221)	1	310	18.6	19.2	0.47
		315	17.6	17.1	.41
	Avg..	312	18.1	18.2	.44
	2	150	12.5	15.3	0.66
		182	13.0	13.7	.66
	Avg..	166	12.8	14.5	.66
	3	142	10.9	18.5	0.42
		151	11.1	18.4	.44
		146	11.0	18.4	.43
Indolene clear, 22 percent aromatic (7203)	1	347	19.2	15.9	0.42
		339	17.1	16.8	.39
	Avg..	343	18.2	16.4	.40
	2	287	16.1	11.9	0.55
		234	13.5	12.6	.59
	Avg..	260	14.8	12.2	.57
	3	179	12.5	16.2	0.42
		184	11.6	16.1	.43
	Avg..	182	12.0	16.2	.42
1970 PONTIAC (CAR 400) WITH A 400-CID ENGINE					
Typical clear II, 40 percent aromatic (7221)	1	467	26.5	25.8	0.74
		455	26.5	29.5	.60
	Avg..	461	26.5	27.6	.67
	2	45.7	22.5	36.0	1.3
		53.8	24.2	41.5	1.0
	Avg..	49.8	23.4	38.8	1.2
	3	49.3	15.8	33.0	1.0
		52.2	16.5	35.6	.86
	Avg..	50.8	16.2	34.3	.93
Indolene clear, 22 percent aromatic (7203)	1	507	40.9	23.9	0.71
		390	24.3	27.2	.80
	Avg..	448	32.6	25.6	.76
	2	88.6	25.7	35.6	1.1
		49.5	17.7	39.9	1.3
	Avg..	69.0	21.7	37.8	1.2
	3	70.7	17.4	35.6	0.88
		49.6	13.2	31.2	.95
	Avg..	60.2	15.3	33.4	.92

See footnotes at end of table.

TABLE A-1. - Mass emissions for individual bags of the 1975 Federal test procedure and individual replicate tests from 1970 to 1973 vehicles 1/—Continued

Fuel	Bag number	Emissions, grams/test			
		Carbon monoxide	Hydrocarbon	Nitrogen oxides 2/	Aldehydes (MBTH)
1970 VOLKSWAGON (CAR 365) WITH A 1,600-CC ENGINE					
Typical clear II, 40 percent aromatic (7221)	1	135	11.9	26.1	0.25
		136	11.6	25.6	.23
		148	12.7	26.4	.29
	Avg..	140	12.1	26.0	.26
	2	108	7.45	21.6	0.28
		129	8.16	21.0	.25
		143	10.4	20.2	.32
	Avg..	127	8.67	20.9	.28
	3	89.0	8.03	22.9	0.23
		80.6	6.83	24.1	.18
		96.8	8.73	24.4	.26
	Avg..	88.8	7.86	23.8	.22
Indolene clear, 22 percent aromatic (7203)	1	139	10.9	29.2	0.29
		137	9.15	26.8	.24
	Avg..	138	10.0	28.0	.26
	2	101	6.60	23.0	.36
		103	6.48	22.3	.34
	Avg..	102	6.54	22.6	.35
	3	75.3	6.42	27.2	0.28
		67.8	5.80	24.8	.23
	Avg..	71.6	6.11	26.0	.26
1971 CHEVROLET VEGA (CAR 68) WITH A 2,300-CC ENGINE					
Typical clear, 40 percent aromatic (7221)	1	348	30.8	6.48	0.29
		354	26.9	6.66	.28
	Avg..	351	28.8	6.57	.28
	2	168	10.8	6.52	0.33
		155	9.54	7.48	.34
	Avg..	162	10.2	7.00	.34
	3	198	31.7	7.45	0.23
		201	18.6	7.64	.23
	Avg..	200	25.2	7.54	.23
Indolene clear, 22 percent aromatic (7203)	1	401	27.5	6.03	0.30
		426	47.0	5.85	.41
	Avg..	414	37.2	5.94	.36
	2	156	8.37	6.35	0.33
		202	11.3	6.06	.40
	Avg..	179	9.84	6.20	.36
	3	189	27.5	6.61	0.25
		192	24.9	6.91	.25
	Avg..	190	26.2	6.76	.25

See footnotes at end of table.

TABLE A-1 . - Mass emissions for individual bags of the 1975 Federal test procedure and individual replicate tests from 1970 to 1973 vehicles 1/—Continued

Fuel	Bag number	Emissions, grams/test			
		Carbon monoxide	Hydrocarbon	Nitrogen oxides 2/	Aldehydes (MBTH)
1973 FORD TORINO (CAR 146) WITH A 351-CID ENGINE					
Typical clear II, 40 percent aromatic (7221)	1	138	13.7	14.4	0.52
		137	13.2	14.4	.48
	Avg..	138	13.4	14.4	.50
	2	68.0	10.3	15.4	0.64
		67.0	10.0	16.5	.64
	Avg..	67.5	10.2	16.0	.64
	3	55.0	9.12	15.5	0.48
		54.0	8.42	16.8	.50
	Avg..	54.5	8.77	16.2	.49
Indolene clear, 22 percent aromatic (7203)	1	115	12.0	14.4	0.43
		123	12.1	15.1	.60
	Avg..	119	12.0	14.8	.52
	2	70.1	10.3	14.4	0.64
		66.9	9.66	14.3	.63
	Avg..	68.5	9.98	14.4	.64
	3	51.7	8.38	14.0	0.50
		45.1	8.66	15.4	.55
	Avg..	48.4	8.52	14.7	.52
1973 CHEVROLET IMPALA (CAR 110) WITH A 350-CID ENGINE					
Typical clear II, 40 percent aromatic (7221)	1	188	10.0	11.0	1.0
		219	11.0	11.1	.59
	Avg..	204	10.5	11.0	.80
	2	104	6.99	8.31	0.75
		118	7.36	8.21	.82
	Avg..	111	7.18	8.26	.78
	3	80.0	7.76	12.4	0.57
		104	8.00	12.2	.59
	Avg..	92.0	7.88	12.3	.58
Indolene clear, 22 percent aromatic (7203)	1	213	11.1	8.83	0.60
		177	9.34	9.99	.61
	Avg..	195	10.2	9.41	.60
	2	119	7.25	7.24	0.76
		93.9	6.58	7.68	.79
	Avg..	106	6.92	7.46	.78
	3	119	9.37	11.1	0.60
		73.4	6.74	11.3	.59
	Avg..	96.2	8.06	11.2	.60

1/ All tests were conducted at 75° F ambient temperature.

2/ NO_x data are corrected for humidity to 75 grains H_2O per lb of dry air.

TABLE A-2. - Mass emissions for individual replicate tests weighted in accordance with the 1975 Federal test procedure from 1970 to 1973 vehicles 1/

Fuel	Emissions, grams/mile			
	Carbon monoxide	Hydrocarbon	Nitrogen oxides 2/	Aldehydes (MBTH)
1972 OLDSMOBILE 98 (CAR 151) WITH A 455-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)	11.9	1.89	4.76	0.13
	11.2	1.65	5.10	.12
	9.52	1.83	5.16	.13
Avg...	10.9	1.79	5.01	.13
Indolene clear, 22 percent aromatic (7203)	15.3	2.12	4.71	0.12
	13.8	1.33	4.68	.12
Avg...	14.6	1.72	4.70	.12
1971 FORD GALAXIE (CAR 707) WITH A 351-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)	54.7	4.45	7.40	0.15
	65.0	5.31	7.28	.13
Avg...	59.8	4.88	7.34	.14
Indolene clear, 22 percent aromatic (7203)	72.9	6.27	6.27	0.14
	53.9	4.86	6.96	.16
Avg...	63.4	5.56	6.62	.15
1971 PLYMOUTH FURY III (CAR 76) WITH A 360-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)	29.3	3.22	8.49	0.19
	30.9	3.23	8.54	.15
Avg...	30.1	3.22	8.52	.17
Indolene clear, 22 percent aromatic (7203)	44.3	3.50	7.19	0.13
	49.6	3.59	8.23	.16
Avg...	47.0	3.54	7.71	.14
1972 FORD TORINO (CAR 769) WITH A 351-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)	35.5	2.08	4.25	0.078
	40.4	2.23	4.38	.073
Avg...	38.0	2.16	4.32	.076
Indolene clear, 22 percent aromatic (7203)	49.4	2.56	3.71	0.075
	35.3	2.02	3.68	.081
Avg...	42.4	2.29	3.70	.078

See footnotes at end of table.

TABLE A-2. - Mass emissions for individual replicate tests weighted in accordance with the 1975 Federal test procedure from 1970 to 1973 vehicles 1/—Continued

Fuel	Emissions, grams/mile			
	Carbon monoxide	Hydrocarbon	Nitrogen oxides 2/	Aldehydes (MBTH)
1970 CHEVROLET IMPALA (CAR 595) WITH A 350-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)	48.5	3.56	4.54	0.15
	53.8	3.59	4.20	.14
Avg...	51.2	3.58	4.37	.14
Indolene clear, 22 percent aromatic (7203)	71.8	4.20	3.73	0.13
	64.6	3.67	3.86	.13
Avg...	68.2	3.94	3.80	.13
1970 PONTIAC (CAR 400) WITH A 400-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)	36.6	5.72	8.78	0.30
	37.2	6.00	9.94	.23
Avg...	36.9	5.86	9.36	.26
Indolene clear, 22 percent aromatic (7203)	46.2	7.09	8.82	0.26
	32.7	4.76	9.26	.30
Avg...	39.4	5.92	9.04	.28
1970 VOLKSWAGON (CAR 365) WITH A 1,600-CC ENGINE				
Typical clear II, 40 percent aromatic (7221)	29.0	2.28	6.12	0.069
	31.1	2.27	6.10	.061
	34.9	2.78	6.06	.079
Avg...	31.7	2.44	6.09	.070
Indolene clear, 22 percent aromatic (7203)	27.2	1.99	6.81	0.086
	26.8	1.83	6.40	.077
Avg...	27.0	1.91	6.60	.082
1971 CHEVROLET VEGA (CAR 68) WITH A 2,300-CC ENGINE				
Typical clear II, 40 percent aromatic (7221)	57.4	5.62	1.81	0.079
	56.2	4.23	1.96	.079
Avg...	56.8	4.92	1.88	.079
Indolene clear, 22 percent aromatic (7203)	58.1	4.78	1.69	0.080
	65.9	6.10	1.67	.095
Avg...	62.0	5.44	1.68	.088

See footnotes at end of table.

TABLE A-2. - Mass emissions for individual replicate tests weighted in accordance with the 1975 Federal test procedure from 1970 to 1973 vehicles 1/—Continued

Fuel	Emissions, grams/mile			
	Carbon monoxide	Hydrocarbon	Nitrogen oxides 2/	Aldehydes (MBTH)
1973 FORD TORINO (CAR 146) WITH A 351-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)	21.2	2.86	4.05	0.15
	20.9	2.73	4.29	.15
Avg...	21.0	2.79	4.17	.15
Indolene clear, 22 percent aromatic (7203)	19.9	2.71	3.80	0.15
	19.4	2.64	3.94	.16
Avg...	19.6	2.68	3.87	.16
1973 CHEVROLET IMPALA (CAR 110) WITH A 350-CID ENGINE				
Typical clear II, 40 percent aromatic (7221)	30.7	2.10	2.68	0.20
	36.2	2.22	2.65	.19
Avg...	33.4	2.16	2.66	.20
Indolene clear, 22 percent aromatic (7203)	37.2	2.32	2.31	0.18
	28.2	1.92	2.46	.18
Avg...	32.7	2.12	2.38	.18

1/ All tests were conducted at 75° F ambient temperature.

2/ NO_x data are corrected for humidity to 75 grains H_2O per lb of dry air.

APPENDIX B -- DATA ON THE INFLUENCE OF FUEL COMPOSITION ON HYDROCARBON DISTRIBUTION IN EXHAUST FROM 1970-1973 VEHICLES

TABLE B-1. - Exhaust hydrocarbon distribution for individual bags of the 1975 Federal test procedure and individual replicate tests from 1970-1973 vehicles 1/

Fuel	Bag number	Total HC, grams/test	Hydrocarbon distribution, weight percent								
			Paraffins			Olefins			Aromatics		Acetylenes
			Methane	C_2-C_5	C_6+	Ethylene	C_3-C_5	C_6+	Benzene	C_7+	
1972 OLDSMOBILE 98 (CAR 151) WITH A 455-CID ENGINE											
Typical clear II, 40 percent aromatic (7221)	1	7.41	-	-	-	-	-	-	-	-	-
		6.55	6.6	6.2	8.4	13.3	10.2	0.4	6.8	37.0	11.1
		6.89	5.1	9.2	13.3	12.2	10.6	.7	6.0	33.8	9.1
	Avg...	6.95	5.9	7.7	10.9	12.7	10.4	.5	6.4	35.4	10.1
	2	7.91	-	-	-	-	-	-	-	-	-
		6.91	1.6	8.1	21.3	8.1	7.6	3.3	3.3	42.5	4.2
		7.83	1.9	10.9	21.8	7.6	8.6	2.7	3.6	39.5	3.4
	Avg...	7.55	1.7	9.5	21.6	7.8	8.1	3.0	3.5	41.0	3.8
	3	5.37	-	-	-	-	-	-	-	-	-
		4.65	3.9	6.2	12.8	12.0	9.5	0.9	5.6	40.2	8.9
		5.18	3.1	10.5	14.1	10.6	9.7	1.4	4.6	38.3	7.7
	Avg...	5.07	3.5	8.4	13.4	11.3	9.6	1.1	5.1	39.3	8.3
Indolene clear, 22 percent aromatic (7203)	1	8.39	8.4	7.0	14.4	15.9	17.6	0.9	4.9	19.6	11.3
		7.77	7.8	8.9	16.4	14.8	17.8	1.3	4.5	17.8	10.7
	Avg...	8.08	8.1	8.0	15.4	15.3	17.7	1.1	4.7	18.7	11.0
	2	8.20	2.5	10.8	30.7	9.7	13.1	3.7	3.8	20.9	4.8
		3.33	5.9	5.3	10.4	22.9	24.0	.5	4.6	14.9	11.5
	Avg...	5.76	4.2	8.1	20.6	16.3	18.5	2.1	4.2	17.9	8.1
	3	7.19	3.8	10.7	27.4	10.4	13.4	2.2	4.0	20.6	7.5
		5.82	5.1	17.2	21.3	12.3	15.1	1.7	3.9	14.5	8.9
	Avg...	6.50	4.4	14.0	24.3	11.4	14.2	2.0	4.0	17.5	8.2
1971 FORD GALAXIE (CAR 707) WITH A 351-CID ENGINE											
Typical clear II, 40 percent aromatic (7221)	1	33.5	12.6	6.7	12.4	6.7	7.4	1.8	4.2	31.4	16.8
		43.8	13.9	7.0	13.8	6.4	7.1	1.8	3.9	27.7	18.4
	Avg...	38.6	13.2	6.8	13.1	6.6	7.3	1.8	4.1	29.5	17.6
	2	12.4	5.2	7.9	10.6	10.4	12.7	1.1	5.4	38.9	7.8
		13.8	4.9	7.1	13.0	9.9	11.2	1.3	5.7	40.4	6.5
	Avg...	13.1	5.1	7.5	11.8	10.1	11.9	1.2	5.6	39.6	7.2
	3	11.4	4.5	8.2	12.9	9.6	10.9	1.3	5.4	40.3	6.9
		12.6	4.5	8.0	13.7	8.9	10.2	1.4	5.3	41.3	6.7
	Avg...	12.0	4.5	8.1	13.3	9.2	10.5	1.4	5.4	40.8	6.8
Indolene clear, 22 percent aromatic (7203)	1	59.2	15.4	7.4	22.2	6.6	7.9	2.5	3.2	15.3	19.5
		41.8	15.8	7.3	19.5	7.6	9.0	1.9	3.2	15.2	20.5
	Avg...	50.5	15.6	7.4	20.8	7.1	8.4	2.2	3.2	15.3	20.0
	2	14.5	7.4	7.8	18.4	12.6	17.2	1.9	4.4	22.7	7.6
		12.2	6.7	7.9	18.0	13.6	18.3	1.6	4.7	21.2	8.0
	Avg...	13.4	7.0	7.9	18.2	13.1	17.7	1.8	4.6	21.9	7.8
	3	12.4	6.9	8.9	20.1	12.3	16.5	1.5	4.4	21.0	8.4
		11.1	6.0	9.1	21.5	12.1	17.5	1.7	4.4	20.1	7.6
	Avg...	11.8	6.5	9.0	20.8	12.2	17.0	1.6	4.4	20.5	8.0
1971 PLYMOUTH FURY III (CAR 76) WITH A 360-CID ENGINE											
Typical clear II, 40 percent aromatic (7221)	1	14.2	4.6	9.2	12.8	9.5	11.5	1.3	4.9	40.2	6.0
		13.8	4.6	9.2	11.8	10.1	11.9	1.0	5.0	40.0	6.4
	Avg...	14.0	4.6	9.2	12.3	9.8	11.7	1.1	5.0	40.1	6.2
	2	12.2	2.8	8.0	13.3	10.8	13.8	1.3	5.0	39.7	5.3
		12.4	2.6	8.2	13.1	10.6	13.4	1.3	5.1	40.3	5.4
	Avg...	12.3	2.7	8.1	13.2	10.7	13.6	1.3	5.1	40.0	5.3
	3	10.3	4.1	7.6	11.1	11.1	12.1	1.1	5.4	40.7	6.8
		10.4	4.4	8.1	11.2	11.1	12.2	1.0	5.5	39.6	6.9
	Avg...	10.4	4.2	7.8	11.2	11.1	12.2	1.1	5.5	40.1	6.8
Indolene clear, 22 percent aromatic (7203)	1	15.7	6.7	10.6	20.6	12.1	17.0	1.8	3.9	20.2	7.1
		14.6	6.6	10.2	19.3	12.8	16.3	1.6	3.9	22.8	6.5
	Avg...	15.2	6.7	10.4	19.9	12.5	16.6	1.7	3.9	21.5	6.8
	2	13.3	5.6	8.1	19.9	13.0	19.3	1.8	4.1	22.0	6.2
		14.3	6.0	8.5	19.7	13.0	19.2	2.1	4.2	21.4	5.9
	Avg...	13.8	5.8	8.3	19.8	13.0	19.3	1.9	4.2	21.7	6.0
	3	10.9	6.2	8.7	18.9	13.4	18.4	1.4	4.3	20.8	7.9
		11.1	6.5	8.6	18.4	13.7	19.3	1.3	4.3	20.5	7.4
	Avg...	11.0	6.3	8.7	18.6	13.6	18.9	1.4	4.3	20.6	7.6

See footnotes at end of table.

TABLE B-1. - Exhaust hydrocarbon distribution for individual bags of the 1975 Federal test procedure and individual replicate tests from 1970-1973 vehicles 1/—Continued

Fuel	Bag number	Total HC, grams/test	Hydrocarbon distribution, weight percent								
			Paraffins			Olefins			Aromatics		Acetylenes
			Methane	C_2-C_5	C_6+	Ethylene	C_3-C_5	C_6+	Benzene	C_7+	
1970 VOLKSWAGON (CAR 365) WITH A 1,600-CC ENGINE											
Typical clear II, 40 percent aromatic	1	11.9	5.0	8.6	15.6	6.6	7.0	1.7	4.2	43.1	8.2
		11.6	9.8	7.7	11.8	10.1	5.1	.9	3.7	37.6	13.3
		12.7	-	-	-	-	-	-	-	-	-
	Avg...	12.1	7.4	8.2	13.7	8.3	6.0	1.3	3.9	40.4	10.8
	2	7.45	5.7	7.1	11.4	11.3	11.5	0.8	6.2	37.4	8.6
		8.16	7.9	6.5	11.7	10.5	9.4	1.1	6.0	37.9	9.0
		10.4	-	-	-	-	-	-	-	-	-
	Avg...	8.67	6.8	6.8	11.6	10.9	10.4	1.0	6.1	37.6	8.8
	3	8.03	4.7	7.8	15.4	7.6	7.8	1.4	4.8	43.1	7.4
		6.88	5.9	7.2	12.0	8.9	8.5	.8	5.5	42.4	8.8
		8.72	-	-	-	-	-	-	-	-	-
	Avg...	7.86	5.3	7.5	13.7	8.3	8.2	1.1	5.1	42.7	8.1
Indolene clear, 22 percent aromatic (7203)	1	10.9	8.1	11.5	21.3	10.2	13.0	1.8	3.6	21.0	9.5
		9.15	7.9	10.9	21.5	9.9	12.0	1.4	3.9	23.1	9.4
	Avg...	10.0	8.0	11.2	21.4	10.0	12.5	1.6	3.7	22.1	9.5
	2	6.60	9.2	7.2	15.0	15.0	18.5	1.1	4.6	19.8	9.6
		6.48	8.4	7.6	15.6	14.8	17.1	1.3	4.8	19.7	10.7
	Avg...	6.54	8.8	7.4	15.3	14.9	17.8	1.2	4.7	19.8	10.1
	3	6.42	8.1	8.9	18.4	12.9	16.6	1.2	4.5	20.4	9.0
		5.80	6.2	9.5	21.2	11.8	14.9	1.5	4.5	20.8	9.6
	Avg...	6.11	7.2	9.2	19.8	12.3	15.8	1.3	4.5	20.6	9.3
1971 CHEVROLET VEGA (CAR 68) WITH A 2,300-CC ENGINE											
Typical clear II, 40 percent aromatic (7221)	1	30.8	9.2	6.9	19.2	7.2	8.3	2.8	3.3	30.7	12.4
		26.9	7.9	6.5	15.5	6.0	6.5	1.8	3.6	40.9	11.3
	Avg...	28.8	8.5	6.7	17.3	6.6	7.4	2.3	3.5	35.8	11.9
	2	10.8	10.3	9.0	16.7	13.8	12.9	2.5	4.5	19.8	10.5
		9.54	8.8	8.2	11.5	13.2	10.5	1.1	5.0	31.0	10.7
	Avg...	10.2	9.5	8.6	14.1	13.5	11.7	1.8	4.8	25.4	10.6
	3	31.7	4.3	12.9	31.6	4.4	9.3	5.0	3.2	24.0	5.3
		18.6	5.2	12.0	20.6	5.5	6.9	2.6	3.6	37.5	6.1
	Avg...	25.2	4.8	12.4	26.1	5.0	8.1	3.8	3.4	30.7	5.7
Indolene clear, 22 percent aromatic (7203)	1	27.5	13.1	6.3	20.4	8.9	10.4	1.6	3.1	19.0	16.7
		47.0	9.2	9.6	11.0	6.0	9.0	3.3	3.1	16.6	12.2
	Avg...	24.5	11.2	8.2	17.7	7.5	9.7	2.4	3.1	17.8	14.4
	2	8.37	13.0	6.9	4.2	17.6	15.0	1.0	4.5	16.2	11.6
		11.3	12.3	6.3	15.9	16.3	15.6	1.8	4.3	16.0	11.5
	Avg...	9.86	12.7	6.6	15.0	16.9	15.3	1.4	4.4	16.1	11.6
	3	27.5	3.9	12.6	37.1	4.9	8.4	4.2	3.2	21.3	4.4
		24.9	4.9	12.6	34.9	5.4	9.2	3.9	3.3	20.1	5.7
	Avg...	26.2	4.4	12.6	36.0	5.1	8.8	4.0	3.3	20.7	5.1
1973 FORD TORINO (CAR 146) WITH A 351-CID ENGINE											
Typical clear II, 40 percent aromatic (7221)	1	13.7	5.7	8.7	13.0	9.9	12.5	1.8	4.9	35.5	8.0
		13.2	5.4	9.4	13.6	9.1	11.7	1.4	4.9	37.3	7.2
	Avg...	13.4	5.6	9.0	13.3	9.5	12.1	1.6	4.9	36.4	7.6
	2	10.3	4.4	7.5	10.8	12.0	13.9	1.1	5.5	38.9	5.9
		10.0	4.8	7.6	10.4	11.9	13.8	1.0	5.4	39.2	5.9
	Avg...	10.2	4.6	7.6	10.6	12.0	13.8	1.1	5.4	39.0	5.9
	3	9.12	3.7	8.4	11.5	10.9	12.1	1.2	5.3	39.8	7.1
		8.42	3.7	8.3	11.0	11.2	12.9	1.1	5.5	39.5	6.8
	Avg...	8.77	3.7	8.4	11.3	11.0	12.5	1.2	5.4	39.6	6.9
Indolene clear, 22 percent aromatic (7203)	1	12.0	6.2	9.8	17.6	12.6	19.7	1.4	4.1	20.6	8.0
		12.1	6.7	12.3	16.5	12.6	18.6	1.1	4.0	19.4	8.8
	Avg...	12.0	6.4	11.0	17.1	12.6	19.1	1.3	4.1	20.0	8.4
	2	10.3	5.4	7.9	16.0	15.1	22.8	1.4	4.2	20.7	6.5
		9.66	5.4	8.0	15.9	15.5	23.2	1.5	4.2	19.8	6.5
	Avg...	9.98	5.4	8.0	15.9	15.3	23.0	1.5	4.2	20.2	6.5
	3	8.38	5.4	8.6	17.5	14.6	20.3	1.3	4.3	19.2	8.8
		8.66	5.1	8.9	18.7	13.9	21.0	1.5	4.1	19.1	7.7
	Avg...	8.52	5.2	8.7	18.1	14.3	20.6	1.4	4.2	19.2	8.3

See footnotes at end of table.

TABLE B-1. - Exhaust hydrocarbon distribution for individual bags of the 1975 Federal test procedure and individual replicate tests from 1970-1973 vehicles 1/—Continued

Fuel	Bag number	Total HC, grams/test	Hydrocarbon distribution, weight percent								
			Paraffins			Olefins			Aromatics		Acetylenes
			Methane	C_2-C_5	C_6+	Ethylene	C_3-C_5	C_6+	Benzene	C_7+	
1972 FORD TORINO (CAR 769) WITH A 351-CID ENGINE											
Typical clear II, 40 percent aromatic (7221)	1	17.6	14.4	5.4	8.1	9.7	6.9	0.7	5.3	30.2	10.3
		18.3	15.2	5.3	7.1	9.8	7.5	.6	5.2	27.5	21.8
	Avg...	18.0	14.8	5.4	7.6	9.7	7.2	.7	5.3	28.8	20.5
	2	4.78	7.4	7.0	8.7	13.3	9.5	0.5	7.4	35.1	11.1
		4.93	9.0	5.8	6.8	14.4	10.5	.3	7.8	33.5	11.9
	Avg...	4.86	8.2	6.4	7.8	13.8	10.0	.4	7.6	34.3	11.5
	3	5.73	6.1	14.0	13.0	9.0	8.9	1.3	5.6	32.7	9.4
		6.87	6.6	14.7	13.5	8.4	9.0	1.4	5.4	31.8	9.2
	Avg...	6.30	6.4	14.3	13.2	8.7	9.0	1.4	5.5	32.2	9.3
Indolene clear, 22 percent aromatic (7203)	1	19.9	17.3	5.1	12.4	11.6	11.0	1.1	3.8	14.5	23.2
		14.6	17.7	4.9	10.5	12.4	11.9	.8	3.9	15.2	22.7
	Avg...	17.2	17.5	5.0	11.5	12.0	11.5	.9	3.9	14.8	22.9
	2	6.34	9.9	7.1	11.1	17.7	14.9	0.6	5.6	19.3	13.8
		4.96	9.3	5.8	13.8	17.8	16.7	.8	5.5	17.7	12.6
	Avg...	5.65	9.6	6.4	12.4	17.8	15.8	.7	5.6	18.5	13.2
	3	7.59	8.7	14.9	18.2	11.2	12.7	1.7	4.5	15.8	12.3
		6.90	7.5	17.5	23.3	9.5	11.7	1.9	4.2	15.1	9.3
	Avg...	7.24	8.1	16.2	20.8	10.3	12.2	1.8	4.4	15.4	10.8
1970 CHEVROLET IMPALA (CAR 595) WITH A 350-CID ENGINE											
Typical clear II, 40 percent aromatic (7221)	1	18.6	7.8	7.0	12.4	8.8	9.2	1.3	4.9	39.6	9.0
		17.6	7.3	7.6	12.0	8.3	9.9	1.2	5.2	39.2	9.3
	Avg...	18.1	7.5	7.3	12.2	8.6	9.5	1.3	5.1	39.4	9.1
	2	12.5	5.9	6.8	10.9	11.0	11.2	1.0	5.6	41.1	6.5
		13.0	5.3	6.8	11.8	10.3	10.3	1.1	5.8	41.8	6.8
	Avg...	12.8	5.6	6.8	11.3	10.7	10.8	1.0	5.7	41.4	6.7
	3	10.9	6.3	6.9	10.4	10.8	11.0	1.0	5.8	40.3	7.5
		11.1	5.9	7.4	10.6	10.6	10.3	1.0	5.9	40.1	8.2
	Avg...	11.0	6.1	7.1	10.5	10.7	10.7	1.0	5.8	40.2	7.9
Indolene clear, 22 percent aromatic (7203)	1	19.2	11.3	8.7	16.9	12.0	14.1	1.4	3.9	19.7	12.0
		17.1	11.0	7.6	16.6	12.5	14.8	1.3	3.8	20.0	12.4
	Avg...	18.2	11.1	8.2	16.7	12.3	14.4	1.4	3.8	19.9	12.2
	2	16.1	8.5	7.3	19.0	12.9	15.5	2.0	4.4	22.0	8.4
		13.5	8.2	7.1	18.3	13.2	16.6	1.6	4.5	22.5	8.0
	Avg...	14.8	8.4	7.2	18.7	13.0	16.0	1.8	4.4	22.3	8.2
	3	12.5	7.9	7.9	17.9	13.5	17.1	1.3	4.3	21.1	8.8
		11.6	8.8	7.3	17.6	13.6	16.5	1.3	4.6	20.4	9.9
	Avg...	12.0	8.4	7.6	17.7	13.6	16.8	1.3	4.5	20.8	9.3
1970 PONTIAC (CAR 400) WITH A 400-CID ENGINE											
Typical clear II, 40 percent aromatic (7221)	1	26.5	8.7	9.7	21.4	8.4	12.3	2.8	4.0	23.6	9.1
		26.5	8.0	8.7	16.1	7.2	9.8	1.9	4.5	34.2	9.6
	Avg...	26.5	8.4	9.2	18.7	7.8	11.0	2.3	4.3	28.9	9.4
	2	22.5	2.0	11.1	26.0	8.8	16.1	4.6	3.6	24.6	3.2
		24.2	1.8	10.0	20.7	6.9	10.8	3.0	3.6	40.4	2.8
	Avg...	23.4	1.9	10.6	23.3	7.8	13.5	3.8	3.6	32.5	3.0
	3	15.8	2.5	10.6	24.1	9.8	15.6	3.2	4.0	25.3	4.9
		16.5	2.4	9.6	18.3	7.9	10.5	2.0	4.2	40.7	4.4
	Avg...	16.2	2.5	10.1	21.2	8.9	13.0	2.6	4.1	33.0	4.6
Indolene clear, 22 percent aromatic (7203)	1	40.9	11.6	9.7	22.0	8.3	11.6	2.1	3.2	16.4	15.1
		24.3	9.2	10.1	23.5	9.4	13.9	2.2	3.6	17.7	10.4
	Avg...	32.6	10.4	9.9	22.8	8.8	12.7	2.2	3.4	17.0	12.8
	2	25.7	2.7	11.4	29.0	8.7	15.9	3.8	3.4	21.7	3.4
		17.7	2.8	10.4	24.1	11.9	20.1	3.6	3.1	20.1	3.9
	Avg...	21.7	2.8	10.9	26.5	10.3	18.0	3.7	3.2	20.9	3.7
	3	17.4	3.2	10.6	26.0	10.2	16.6	2.3	3.7	22.0	5.4
		13.2	3.4	10.1	23.9	11.8	18.2	2.0	3.9	20.6	6.1
	Avg...	15.3	3.3	10.4	24.9	11.0	17.4	2.1	3.8	21.3	5.8

See footnotes at end of table.

TABLE B-1. - Exhaust hydrocarbon distribution for individual bags of the 1975 Federal test procedure and individual replicate tests from 1970-1973 vehicles 1/—Continued

Fuel	Bag number	Total HC, grams/test	Hydrocarbon distribution, weight percent								
			Paraffins			Olefins			Aromatics		Acetylenes
			Methane	C_2-C_5	C_6+	Ethylene	C_3-C_5	C_6+	Benzene	C_7+	
1973 CHEVROLET IMPALA (CAR 110) WITH A 350-CID ENGINE											
Typical clear II, 40 percent aromatic (7221)	1	10.0	9.4	9.0	13.7	10.5	10.6	1.5	5.0	29.7	10.6
		11.0	8.8	8.5	12.9	9.7	9.2	1.2	5.1	34.8	9.8
	Avg...	10.5	9.1	8.8	13.3	10.1	9.9	1.3	5.1	32.2	10.2
	2	6.99	4.9	8.7	13.5	12.1	11.4	1.3	5.4	37.5	5.2
		7.36	5.9	8.1	13.9	11.5	11.3	1.4	5.6	37.1	5.2
	Avg...	7.18	5.4	8.4	13.7	11.8	11.3	1.4	5.5	37.3	5.2
	3	7.76	3.9	9.9	16.7	9.1	9.5	1.9	4.7	39.5	4.8
		8.00	4.7	9.2	15.9	9.1	9.1	1.9	4.7	40.9	4.5
	Avg...	7.88	4.3	9.5	16.3	9.1	9.3	1.9	4.7	40.2	4.7
Indolene clear, 22 percent aromatic (7203)	1	11.1	11.6	7.9	19.6	12.3	13.6	1.8	4.3	16.7	12.2
		9.34	9.5	9.7	19.4	11.6	14.2	1.5	4.1	19.6	10.4
	Avg...	10.2	10.6	8.8	19.5	12.0	13.9	1.6	4.2	18.1	11.3
	2	7.25	6.6	8.4	19.4	15.5	17.9	1.7	4.6	20.4	5.5
		6.58	6.9	9.4	19.4	15.0	17.9	1.6	4.2	19.5	6.1
	Avg...	6.92	6.8	8.9	19.4	15.2	17.9	1.7	4.4	19.9	5.8
	3	9.37	5.4	15.5	26.5	9.3	13.0	2.6	3.8	18.8	5.1
		6.74	5.2	11.1	24.8	12.2	14.1	2.1	4.2	20.4	5.9
	Avg...	8.06	5.3	13.3	25.7	10.8	13.5	2.3	4.0	19.6	5.5

1/ All tests were conducted at 75° F ambient temperature.

TABLE B-2. - Exhaust hydrocarbon distribution for individual replicate tests weighted in accordance with the 1975 Federal test procedure for 1970-1973 vehicles 1/

Fuel	Total HC, grams/mile	Hydrocarbon distribution, weight percent								
		Paraffins			Olefins			Aromatics		Acetylenes
		Methane	C_2-C_5	C_6+	Ethylene	C_3-C_5	C_6+	Benzene	C_7+	
1972 OLDSMOBILE 98 (CAR 151) WITH A 455-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)	1.89	-	-	-	-	-	-	-	-	-
	1.65	3.2	7.3	16.6	10.1	8.6	2.1	4.6	40.7	6.8
	1.83	2.8	10.4	18.3	9.2	9.3	2.0	4.3	38.1	5.6
Avg..	1.79	3.0	8.8	17.4	9.6	9.0	2.1	4.5	39.4	6.2
Indolene clear, 22 percent aromatic (7203)	2.12	4.2	9.9	26.1	11.3	14.2	2.7	4.1	20.5	7.0
	1.33	6.3	10.5	16.0	16.7	19.0	1.1	4.3	15.7	10.4
Avg..	1.72	5.3	10.2	21.0	14.0	16.6	1.9	4.2	18.1	8.7
1971 FORD GALAXIE (CAR 707) WITH A 351-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)	4.45	8.3	7.5	11.8	8.7	10.0	1.4	4.9	35.9	11.5
	5.31	9.1	7.2	13.5	8.1	9.1	1.5	4.8	34.5	12.2
Avg..	4.88	8.7	7.4	12.6	8.4	9.6	1.5	4.8	35.2	11.8
Indolene clear, 22 percent aromatic (7203)	6.27	11.7	7.7	20.8	9.3	12.0	2.2	3.7	18.4	14.2
	4.86	11.0	7.8	19.3	10.4	13.6	1.8	3.9	18.1	14.1
Avg..	5.56	11.4	7.8	20.0	9.8	12.8	2.0	3.8	18.2	14.2
1971 PLYMOUTH FURY III (CAR 76) WITH A 360-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)	3.22	3.6	8.2	12.7	10.6	12.8	1.2	5.0	40.1	5.8
	3.23	3.5	8.4	12.4	10.6	12.7	1.2	5.1	40.1	6.0
Avg..	3.22	3.6	8.3	12.5	10.6	12.7	1.2	5.1	40.1	5.9
Indolene clear 22 percent aromatic (7203)	3.50	6.0	8.9	19.9	12.8	18.5	1.7	4.1	21.3	6.8
	3.59	6.3	8.9	19.3	13.1	18.5	1.8	4.2	21.5	6.4
Avg..	3.54	6.1	8.9	19.6	12.9	18.5	1.7	4.2	21.4	6.7
1972 FORD TORINO (CAR 769) WITH A 351-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)	2.08	10.5	7.7	9.3	10.7	8.1	0.8	6.0	32.2	14.7
	2.23	11.4	7.7	8.5	10.8	8.7	.7	6.0	30.3	15.9
Avg..	2.16	10.9	7.7	8.9	10.8	8.4	.8	6.0	31.2	15.3
Indolene clear, 22 percent aromatic (7203)	2.56	12.9	8.0	13.3	13.5	12.7	1.1	4.5	16.4	17.6
	2.02	12.3	8.5	14.9	13.4	13.4	1.1	4.5	16.0	15.9
Avg..	2.29	12.6	8.2	14.1	13.5	13.0	1.1	4.5	16.2	16.8
1970 CHEVROLET IMPALA (CAR 595) WITH A 350-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)	3.56	6.6	6.9	11.2	10.3	10.5	1.1	5.4	40.5	7.5
	3.59	6.0	7.2	11.6	9.8	10.2	1.1	5.6	40.7	7.8
Avg..	3.58	6.3	7.0	11.4	10.0	10.4	1.1	5.5	40.6	7.7
Indolene clear, 22 percent aromatic (7203)	4.20	9.1	7.8	18.2	12.8	15.5	1.7	4.3	21.2	9.4
	3.67	9.1	7.3	17.7	13.1	16.1	1.5	4.3	21.3	9.6
Avg..	3.94	9.1	7.5	17.9	13.0	15.8	1.6	4.3	21.3	9.5
1970 PONTIAC (CAR 400) WITH A 400-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)	5.72	3.9	10.6	24.4	8.9	15.0	3.8	3.8	24.5	5.1
	6.00	3.5	9.6	19.0	7.2	10.5	2.5	3.9	38.9	4.9
Avg..	5.86	3.7	10.1	21.7	8.0	12.8	3.1	3.9	31.7	5.0
Indolene clear, 22 percent aromatic (7203)	7.09	5.7	10.7	26.1	8.8	14.6	3.0	3.4	20.0	7.7
	4.76	4.8	10.2	23.9	11.1	17.9	2.8	3.5	19.5	6.3
Avg..	5.92	5.2	10.5	25.0	9.9	16.3	2.9	3.5	19.7	7.0

See footnotes at end of table.

TABLE B-2. - Exhaust hydrocarbon distribution for individual replicate tests weighted in accordance with the 1975 Federal test procedure for 1970-1973 vehicles 1/—Continued

Fuel	Total HC, grams/mile	Hydrocarbon distribution, weight percent								
		Paraffin			Olefins			Aromatics		Acetylenes
		Methane	C_2-C_5	C_6+	Ethylene	C_3-C_5	C_6+	Benzene	C_7+	
1970 VOLKSWAGON (CAR 365) WITH A 1,600-CC ENGINE										
Typical clear II, 40 percent aromatic (7221)	2.28	5.2	7.7	13.7	8.9	9.2	1.2	5.2	40.7	8.2
	2.27	8.0	7.0	11.8	10.0	7.9	1.0	5.2	38.9	10.2
	2.78	-	-	-	-	-	-	-	-	-
Avg..	2.44	6.6	7.3	12.8	9.4	8.6	1.1	5.2	39.8	9.2
Indolene clear, 22 percent aromatic (7203)	1.99	8.6	9.0	17.8	13.0	16.3	1.3	4.2	20.4	9.4
	1.83	7.7	9.0	18.6	12.7	15.1	1.4	4.5	20.9	10.1
Avg..	1.91	8.1	9.0	18.2	12.9	15.7	1.4	4.3	20.6	9.8
1971 CHEVROLET VEGA (CAR 68) WITH A 2,300-CC ENGINE										
Typical clear II, 40 percent aromatic (7221)	5.62	7.4	10.0	23.9	7.7	9.9	3.7	3.6	25.0	8.8
	4.23	7.3	8.9	16.0	8.0	7.8	1.9	4.0	36.7	9.4
Avg..	4.92	7.4	9.4	19.9	7.9	8.8	2.8	3.8	30.9	9.1
Indolene clear, 22 percent aromatic (7203)	4.78	9.0	9.4	26.2	9.2	10.6	2.6	3.5	19.4	10.1
	6.10	8.6	9.7	28.5	8.4	10.7	3.1	3.5	17.5	10.0
Avg..	5.44	8.8	9.5	27.4	8.8	10.7	2.8	3.4	18.5	10.1
1973 FORD TORINO (CAR 146) WITH A 351-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)	2.86	4.6	8.0	11.6	11.1	13.1	1.3	5.3	38.2	6.8
	2.73	4.7	8.3	11.4	10.9	13.0	1.1	5.3	38.8	6.5
Avg..	2.79	4.7	8.1	11.5	11.0	13.1	1.2	5.3	38.5	6.6
Indolene clear, 22 percent aromatic (7203)	2.71	5.6	8.6	16.7	14.4	21.4	1.4	4.2	20.3	7.4
	2.64	5.7	9.4	16.7	14.3	21.5	1.4	4.1	19.5	7.4
Avg..	2.68	5.6	9.0	16.7	14.4	21.4	1.4	4.2	19.9	7.4
1973 CHEVROLET IMPALA (CAR 110) WITH A 350-CID ENGINE										
Typical clear II, 40 percent aromatic (7221)	2.10	5.9	9.1	14.4	10.8	10.6	1.6	5.1	35.9	6.6
	2.22	6.4	8.5	14.2	10.3	10.1	1.5	5.2	37.5	6.3
Avg..	2.16	6.1	8.8	14.3	10.6	10.3	1.6	5.2	36.7	6.4
Indolene clear, 22 percent aromatic (7203)	2.32	7.6	10.4	21.7	12.7	15.2	2.0	4.3	18.9	7.2
	1.92	7.2	9.9	20.9	13.3	15.8	1.8	4.2	19.7	7.2
Avg..	2.12	7.4	10.1	21.3	13.0	15.5	1.9	4.3	19.3	7.2

1/All tests were conducted at 75° F ambient temperature.

APPENDIX C -- DATA ON THE INFLUENCE OF FUEL COMPOSITION ON EXHAUST HYDROCARBON REACTIVITY FOR 1970-1973 VEHICLES

TABLE C-1. - Exhaust hydrocarbon reactivity for individual bags of the 1975 Federal test procedure and individual replicate tests for 1970-1973 vehicles 1/

Fuel	Bag number	Total HC, grams/test	Average molecular weight of HC	Hydrocarbon reactivity			
				Reactivity per mole of HC		Reactivity per gram of HC	
				HEW	GM	HEW	GM
1972 OLDSMOBILE 98 (CAR 151) WITH A 455-CID ENGINE							
Typical clear II, 40 percent aromatic (7221)	1	7.41	-	-	-	-	-
		6.55	45.6	2.35	1.99	0.0511	0.0436
		6.89	49.2	2.44	2.20	.0496	.0447
	Avg....	6.95	47.4	2.40	2.10	.0504	.0442
	2	7.91	-	-	-	-	-
		6.91	63.1	2.88	2.85	0.0456	0.0452
		7.83	63.6	2.86	2.90	.0450	.0456
	Avg....	7.55	63.4	2.87	2.88	.0453	.0454
	3	5.37	-	-	-	-	-
		4.65	51.8	2.59	2.32	0.0500	0.0448
		5.18	44.2	2.26	2.18	.0511	.0493
	Avg....	5.07	48.0	2.42	2.25	.0506	.0470
Indolene clear, 22 percent aromatic (7203)	1	8.39	41.4	2.47	2.28	0.0597	0.0551
		7.77	42.5	2.47	2.38	.0581	.0560
	Avg....	8.08	42.0	2.47	2.33	.0589	.0556
	2	8.20	57.4	2.76	3.02	0.0481	0.0526
		3.33	39.1	2.96	2.62	.0757	.0670
	Avg....	5.76	48.2	2.86	2.82	.0619	.0598
	3	7.19	53.2	2.57	2.74	0.0483	0.0515
		5.82	48.0	2.42	2.61	.0504	.0544
	Avg....	6.50	50.6	2.50	2.68	.0494	.0530
1971 FORD GALAXIE (CAR 707) WITH A 351-CID ENGINE							
Typical clear II, 40 percent aromatic (7221)	1	33.5	40.9	1.51	1.44	0.0369	0.0352
		43.8	39.3	1.36	1.33	.0346	.0338
	Avg....	38.6	40.1	1.44	1.38	.0358	.0345
	2	12.4	50.4	2.65	2.42	0.0526	0.0480
		13.8	52.9	2.67	2.45	.0505	.0463
	Avg....	13.1	51.6	2.66	2.44	.0516	.0472
	3	11.4	53.6	2.65	2.49	0.0494	0.0464
		12.6	54.8	2.63	2.49	.0480	.0454
	Avg....	12.0	54.2	2.64	2.49	.0487	.0459
Indolene clear, 22 percent aromatic (7203)	1	59.2	37.8	1.22	1.32	0.0322	0.0349
		41.8	36.5	1.27	1.33	.0347	.0364
	Avg....	50.5	37.2	1.24	1.32	.0334	.0356
	2	14.5	46.0	2.60	2.50	0.0565	0.0543
		12.2	45.5	2.68	2.58	.0589	.0567
	Avg....	13.4	45.8	2.64	2.54	.0577	.0555
	3	12.4	46.6	2.54	2.52	0.0545	0.0541
		11.1	47.8	2.65	2.67	.0554	.0558
	Avg....	11.8	47.2	2.60	2.60	.0550	.0550
1971 PLYMOUTH FURY III (CAR 76) WITH A 360-CID ENGINE							
Typical clear II, 40 percent aromatic (7221)	1	14.2	53.6	2.71	2.49	0.0506	0.0464
		13.8	52.4	2.70	2.46	.0515	.0469
	Avg....	14.0	53.0	2.70	2.48	.0510	.0466
	2	12.2	55.1	3.05	2.81	0.0554	0.0510
		12.4	55.2	2.99	2.79	.0542	.0505
	Avg....	12.3	55.2	3.02	2.80	.0547	.0508
	3	10.3	53.0	2.83	2.59	0.0534	0.0489
		10.4	52.0	2.75	2.54	.0494	.0488
	Avg....	10.4	52.5	2.79	2.56	.0514	.0488
Indolene clear, 22 percent aromatic (7203)	1	15.7	47.1	2.59	2.58	0.0550	0.0548
		14.6	47.2	2.64	2.55	.0559	.0540
	Avg....	15.2	47.2	2.62	2.56	.0554	.0544
	2	13.3	47.9	2.86	2.80	0.0597	0.0584
		14.3	47.8	2.84	2.81	.0594	.0588
	Avg....	13.8	47.8	2.85	2.80	.0596	.0586
	3	10.9	46.5	2.72	2.68	0.0585	0.0576
		11.1	46.1	2.76	2.69	.0599	.0584
	Avg....	11.0	46.3	2.74	2.68	.0588	.0580

See footnotes at end of table.

TABLE C-1. - Exhaust hydrocarbon reactivity for individual bags of the 1975 Federal test procedure and individual replicate tests for 1970-1973 vehicles 1/—Continued

Fuel	Bag number	Total HC, grams/test	Average molecular weight of HC	Hydrocarbon reactivity			
				Reactivity per mole of HC		Reactivity per gram of HC	
				HEW	GM	HEW	GM
1970 VOLKSWAGON (CAR 365) WITH A 1,600-CC ENGINE							
Typical clear II, 40 percent aromatic (7221)	1	11.9	54.9	2.29	2.15	0.0417	0.0391
		11.6	43.9	1.77	1.55	.0403	.0353
		12.7	52.4	2.26	2.11	.0431	.0402
	Avg....	12.1	50.4	2.11	1.94	.0417	.0382
	2	7.45	48.2	2.47	2.18	0.0512	0.0452
		8.16	47.2	2.23	2.03	.0472	.0430
		10.4	49.4	2.37	2.11	.0479	.0427
	Avg....	8.67	48.3	2.36	2.11	.0488	.0436
	3	8.03	55.2	2.41	2.26	0.0436	0.0409
		6.83	51.4	2.34	2.10	.0455	.0408
		8.73	52.5	2.41	2.17	.0459	.0413
	Avg....	7.86	53.0	2.39	2.18	.0450	.0410
Indolene clear, 22 percent aromatic (7203)	1	10.9	46.3	2.19	2.18	0.0473	0.0470
		9.15	46.5	2.16	2.11	.0464	.0453
	Avg....	10.0	46.4	2.18	2.14	.0468	.0462
	2	6.60	41.8	2.49	2.35	0.0595	0.0562
		6.48	41.6	2.38	2.27	.0572	.0545
	Avg....	6.54	41.7	2.44	2.31	.0584	.0554
	3	6.42	44.2	2.44	2.31	0.0552	0.0522
		5.80	53.7	2.01	2.01	.0374	.0374
	Avg....	6.11	49.0	2.22	2.16	.0463	.0448
1971 CHEVROLET VEGA (CAR 68) WITH A 2,300-CC ENGINE							
Typical clear II, 40 percent aromatic (7221)	1	30.8	46.8	1.88	1.86	0.0401	0.0397
		26.9	50.0	1.95	1.86	.0390	.0372
	Avg....	28.8	48.4	1.92	1.86	.0396	.0384
	2	10.8	41.6	2.12	2.10	0.0509	0.0504
		9.54	43.2	2.16	1.94	.0500	.0449
	Avg....	10.2	42.4	2.14	2.02	.0504	.0476
	3	31.7	61.5	2.31	2.86	0.0375	0.0465
		18.6	57.8	2.24	2.37	.0387	.0410
	Avg....	25.2	59.6	2.28	2.62	.0381	.0438
Indolene clear, 22 percent aromatic (7203)	1	27.5	39.3	1.58	1.57	0.0402	0.0399
		47.0	47.5	1.67	1.93	.0351	.0406
	Avg....	37.2	43.4	1.62	1.75	.0376	.0402
	2	8.37	37.2	2.09	1.93	0.0561	0.0518
		11.3	38.4	2.14	2.59	.0557	.0674
	Avg....	9.84	37.8	2.12	2.26	.0559	.0596
	3	27.5	63.3	2.30	2.85	0.0363	0.0450
		24.9	59.2	2.19	2.71	.0369	.0457
	Avg....	26.2	61.2	2.24	2.78	.0366	.0454
1973 FORD TORINO (CAR 146) WITH A 351-CID ENGINE							
Typical clear II, 40 percent aromatic (7221)	1	13.7	50.3	2.56	2.39	0.0508	0.0475
		13.2	51.7	2.54	2.39	.0491	.0462
	Avg....	13.4	51.0	2.55	2.39	.0500	.0468
	2	10.3	51.7	2.91	2.67	0.0562	0.0516
		10.0	50.9	2.85	2.58	.0559	.0506
	Avg....	10.2	51.3	2.88	2.62	.0560	.0511
	3	9.12	53.4	2.82	2.64	0.0528	0.0494
		8.42	52.7	2.84	2.62	.0538	.0497
	Avg....	8.77	53.0	2.83	2.63	.0533	.0496
Indolene clear, 22 percent aromatic (7203)	1	12.0	46.2	2.73	2.66	0.0590	0.0575
		12.1	45.0	2.57	2.47	.0571	.0548
	Avg....	12.0	45.6	2.65	2.56	.0580	.0562
	2	10.3	46.1	3.05	2.95	0.0661	0.0639
		9.66	45.6	3.06	2.95	.0671	.0646
	Avg....	9.98	45.8	3.06	2.95	.0666	.0642
	3	8.38	46.0	2.83	2.76	0.0615	0.0600
		8.66	47.1	2.91	2.88	.0617	.0611
	Avg....	8.52	46.6	2.87	2.82	.0616	.0606

See footnotes at end of table.

TABLE C-1. - Exhaust hydrocarbon reactivity for individual bags of the 1975 Federal test procedure and individual replicate tests for 1970-1973 vehicles 1/—Continued

Fuel	Bag number	Total HC, grams/test	Average molecular weight of HC	Hydrocarbon reactivity			
				Reactivity per mole of HC		Reactivity per gram of HC	
				HEW	GM	HEW	GM
1972 FORD TORINO (CAR 769) WITH A 351-CID ENGINE							
Typical clear II, 40 percent aromatic (7221)	1	17.6	37.1	1.44	1.26	0.0388	0.0340
		18.3	35.6	1.37	1.20	.0387	.0337
	Avg....	18.0	36.4	1.40	1.23	.0388	.0338
	2	4.78	44.0	2.18	1.87	0.0495	0.0425
		4.93	42.0	2.16	1.87	.0514	.0445
	Avg....	4.86	43.0	2.17	1.87	.0504	.0435
	3	5.73	49.0	2.10	2.17	0.0428	0.0443
		6.87	49.3	2.06	2.05	.0418	.0416
	Avg....	6.30	49.2	2.08	2.11	.0423	.0430
Indolene clear, 22 percent aromatic (7203)	1	19.9	33.1	1.37	1.28	0.0414	0.0387
		14.6	32.7	1.43	1.31	.0437	.0401
	Avg....	17.2	32.9	1.40	1.30	.0426	.0394
	2	6.34	38.0	2.18	1.93	0.0574	0.0508
		4.96	39.2	2.33	2.12	.0594	.0541
	Avg....	5.65	38.6	2.26	2.02	.0584	.0524
	3	7.59	43.0	1.97	2.09	0.0458	0.0486
		6.90	47.0	1.99	2.24	.0423	.0476
	Avg....	7.24	45.0	1.98	2.16	.0440	.0481
1970 CHEVROLET IMPALA (CAR 595) WITH A 350-CID ENGINE							
Typical clear II, 40 percent aromatic (7221)	1	18.6	48.8	2.24	2.04	0.0459	0.0418
		17.6	48.9	2.24	2.06	.0458	.0421
	Avg....	18.1	48.8	2.24	2.05	.0458	.0420
	2	12.5	51.0	2.64	2.38	0.0518	0.0467
		13.0	51.7	2.58	2.32	.0500	.0449
	Avg....	12.8	51.4	2.61	2.35	.0509	.0458
	3	10.9	50.0	2.54	2.30	0.0500	0.0460
		11.1	50.0	2.48	2.26	.0496	.0452
	Avg....	11.0	50.0	2.51	2.28	.0498	.0456
Indolene clear, 22 percent aromatic (7203)	1	19.2	40.5	2.02	1.94	0.0499	0.0479
		17.1	40.5	2.09	2.00	.0516	.0494
	Avg....	18.2	40.5	2.06	1.97	.0508	.0486
	2	16.1	44.6	2.42	2.35	0.0543	0.0527
		13.5	44.8	2.52	2.43	.0562	.0542
	Avg....	14.8	44.7	2.47	2.39	.0552	.0534
	3	12.5	44.4	2.51	2.42	0.0565	0.0545
		11.6	43.1	2.39	2.29	.0554	.0531
	Avg....	12.0	43.8	2.45	2.36	.0560	.0538
1970 PONTIAC (CAR 400) WITH A 400-CID ENGINE							
Typical clear II, 40 percent aromatic (7221)	1	26.5	47.4	2.14	2.21	0.0451	0.0466
		26.5	49.0	2.10	2.05	.0428	.0418
	Avg....	26.5	48.2	2.12	2.13	.0440	.0442
	2	22.5	60.7	3.21	3.43	0.0528	0.0565
		24.2	65.5	3.12	3.14	.0476	.0479
	Avg....	23.4	63.1	3.16	3.28	.0502	.0522
	3	15.8	57.9	3.06	3.23	0.0528	0.0557
		16.5	61.6	2.95	2.91	.0478	.0472
	Avg....	16.2	59.8	3.00	3.07	.0503	.0514
Indolene clear, 22 percent aromatic (7203)	1	40.9	41.3	1.67	1.78	0.0404	0.0430
		24.3	45.1	2.09	2.15	.0463	.0476
	Avg....	32.6	43.2	1.88	1.96	.0434	.0453
	2	25.7	59.2	3.04	3.28	0.0513	0.0554
		17.7	54.7	3.29	3.48	.0601	.0636
	Avg....	21.7	57.0	3.16	3.38	.0557	.0595
	3	17.4	52.0	2.80	2.97	0.0538	0.0571
		13.2	53.2	3.01	3.14	.0565	.0590
	Avg....	15.3	52.6	2.91	3.06	.0552	.0580

See footnotes at end of table.

TABLE C-1. - Exhaust hydrocarbon reactivity for individual bags of the 1975 Federal test procedure and individual replicate tests for 1970-1973 vehicles 1/—Continued

Fuel	Bag number	Total HC, grams/test	Average molecular weight of HC	Hydrocarbon reactivity			
				Reactivity per mole of HC		Reactivity per gram of HC	
				HEW	GM	HEW	GM
1973 CHEVROLET IMPALA (CAR 110) WITH A 350-CID ENGINE							
Typical clear II, 40 percent aromatic (7221)	1	10.0	44.2	2.05	1.91	0.0463	0.0432
		11.0	46.2	2.07	1.90	.0448	.0411
	Avg....	10.5	45.2	2.06	1.90	.0456	.0422
	2	6.99	52.0	2.74	2.57	0.0526	0.0494
		7.36	50.9	2.62	2.45	.0514	.0481
	Avg....	7.18	51.4	2.68	2.51	.0520	.0488
	3	7.76	57.3	2.71	2.66	0.0472	0.0464
		8.00	56.0	2.65	2.53	.0471	.0451
	Avg....	7.88	56.6	2.68	2.60	.0472	.0458
Indolene clear, 22 percent aromatic (7203)	1	11.1	40.4	1.96	2.56	0.0485	0.0633
		9.34	43.3	2.15	2.11	.0496	.0487
	Avg....	10.2	41.8	2.06	2.34	.0490	.0560
	2	7.25	46.0	2.77	2.72	0.0602	0.0591
		6.58	45.6	2.71	2.65	.0594	.0581
	Avg....	6.92	45.8	2.74	2.68	.0598	.0586
	3	9.37	53.0	2.44	2.78	0.0460	0.0524
		6.74	50.8	2.64	2.74	.0519	.0539
	Avg....	8.06	51.9	2.54	2.76	.0490	.0532

1/ All tests were conducted at 75° F ambient temperature

TABLE C-2. - Exhaust hydrocarbon reactivity for individual replicate test weighted in accordance with the 1975 Federal test procedure for 1970-1973 vehicles 1/

Fuel	Total HC, grams/mile	Average molecular weight of HC	Hydrocarbon reactivity			
			Reactivity per mole of HC		Reactivity per gram of HC	
			HEW	GM	HEW	GM
1972 OLDSMOBILE 98 (CAR 151) WITH A 455-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)	1.89	-	-	-	-	-
	1.65	55.6	2.67	2.49	0.0480	0.0448
	1.83	55.0	2.60	2.54	.0473	.0462
Avg....	1.79	55.3	2.64	2.52	.0476	.0455
Indolene clear, 22 percent aromatic (7203)	2.12	51.8	2.63	2.74	0.0508	0.0529
	1.33	42.9	2.63	2.53	.0613	.0590
Avg....	1.72	47.4	2.63	2.64	.0560	.0560
1971 FORD GALAXIE (CAR 707) WITH A 351-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)	4.45	46.3	2.09	1.95	0.0451	0.0421
	5.31	45.7	1.94	1.84	.0424	.0402
Avg....	4.88	46.0	2.02	1.90	.0438	.0412
Indolene clear, 22 percent aromatic (7203)	6.27	41.2	1.77	1.80	0.0429	0.0436
	4.86	40.9	1.89	1.91	.0462	.0466
Avg....	5.56	41.0	1.83	1.86	.0446	.0451
1971 PLYMOUTH FURY III (CAR 76) WITH A 360-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)	3.22	54.2	2.91	2.67	0.0537	0.0493
	3.23	53.7	2.86	2.64	.0532	.0492
Avg....	3.22	54.0	2.88	2.66	.0534	.0492
Indolene clear, 22 percent aromatic (7203)	3.50	47.4	2.76	2.71	0.0582	0.0572
	3.59	47.2	2.78	2.72	.0589	.0576
Avg....	3.54	47.3	2.77	2.72	.0586	.0574
1972 FORD TORINO (CAR 769) WITH A 351-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)	2.08	41.2	1.77	1.61	0.0430	0.0391
	2.23	40.0	1.73	1.55	.0432	.0388
Avg....	2.16	40.6	1.75	1.58	.0431	.0390
Indolene clear, 22 percent aromatic (7203)	2.56	36.6	1.74	1.64	0.0475	0.0448
	2.02	37.7	1.83	1.76	.0485	.0467
Avg....	2.29	37.2	1.78	1.70	.0480	.0458
1970 CHEVROLET IMPALA (CAR 595) WITH A 350-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)	3.56	50.1	2.49	2.26	0.0497	0.0451
	3.59	50.5	2.46	2.23	.0487	.0442
Avg....	3.58	50.3	2.48	2.24	.0492	.0446
Indolene clear, 22 percent aromatic (7203)	4.20	43.4	2.32	2.25	0.0534	0.0518
	3.67	43.2	2.37	2.27	.0549	.0525
Avg....	3.94	43.3	2.34	2.26	.0542	.0522

See footnotes at end of table.

TABLE C-2. - Exhaust hydrocarbon reactivity for individual replicate test weighted in accordance with the 1975 Federal test procedure for 1970-1973 vehicles 1/—Continued

Fuel	Total HC, grams/mile	Average molecular weight of HC	Hydrocarbon reactivity			
			Reactivity per mole of HC		Reactivity per gram of HC	
			HEW	GM	HEW	GM
1970 PONTIAC (CAR 400) WITH A 400-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)	5.72	55.9	2.84	3.01	0.0508	0.0538
	6.00	59.6	2.77	2.76	.0464	.0463
Avg....	5.86	57.8	2.80	2.88	.0486	.0500
Indolene clear, 22 percent aromatic (7203)	7.09	50.7	2.44	2.62	0.0481	0.0516
	4.76	51.2	2.84	2.96	.0554	.0578
Avg....	5.92	51.0	2.64	2.79	.0518	.0547
1970 VOLKSWAGON (CAR 365) WITH A 1,600-CC ENGINE						
Typical clear II, 40 percent aromatic (7221)	2.28	51.8	2.37	2.19	0.0457	0.0422
	2.27	47.0	2.11	1.90	.0448	.0404
	2.78	50.8	2.35	2.12	.0462	.0417
Avg...	2.44	49.9	2.28	2.07	.0456	.0414
Indolene clear, 22 percent aromatic (7203)	1.99	43.7	2.39	2.29	0.0546	0.0524
	1.83	45.5	2.25	2.17	.0494	.0476
Avg....	1.91	44.6	2.32	2.23	.0520	.0500
1971 CHEVROLET VEGA (CAR 68) WITH A 2,300-CC ENGINE						
Typical clear II, 40 percent aromatic (7221)	5.62	50.3	2.10	2.29	0.0417	0.0455
	4.23	49.9	2.11	2.04	.0422	.0408
Avg....	4.92	50.1	2.10	2.16	.0420	.0432
Indolene clear, 22 percent aromatic (7203)	4.78	46.4	1.96	2.09	0.0422	0.0450
	6.10	47.6	1.94	2.33	.0407	.0489
Avg....	5.44	47.0	1.95	2.21	.0414	.0470
1973 FORD TORINO (CAR 146) WITH A 351-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)	2.86	51.7	2.79	2.58	0.0539	0.0499
	2 73	51.5	2.76	2.54	.0535	.0493
Avg....	2.79	51.6	2.78	2.56	.0537	.0496
Indolene clear, 22 percent aromatic (7203)	2.71	46.1	2.91	2.83	0.0631	0.0613
	2.64	45.8	2.89	2.80	.0631	.0611
Avg....	2.68	46.0	2.90	2.82	.0631	.0612
1973 CHEVROLET IMPALA (CAR 110) WITH A 350-CID ENGINE						
Typical clear II, 40 percent aromatic (7221)	2.10	50.9	2.52	2.38	0.0495	0.0467
	2.22	50.7	2.46	2.30	.0485	.0453
Avg....	2.16	50.8	2.49	2.34	.0490	.0460
Indolene clear, 22 percent aromatic (7203)	2.32	46.1	2.43	2.68	0.0527	0.0581
	1.92	46.2	2.52	2.51	.0545	.0543
Avg....	2.12	46.2	2.48	2.60	.0536	.0562

1/ All tests were conducted at 75° F ambient temperature.

APPENDIX D -- DATA ON THE INFLUENCE OF FUEL COMPOSITION ON EXHAUST HYDROCARBON REACTIVITY FOR PROTOTYPE LOW EMISSION SYSTEMS

TABLE D-1. - Exhaust hydrocarbon reactivity for individual bags of the 1975 Federal test procedure and individual replicate tests for prototype low emission systems 1/

Fuel	Bag number	Total HC, grams/test	Average molecular weight of HC	Hydrocarbon reactivity			
				Reactivity per mole of HC		Reactivity per gram of HC	
				HEW	GM	HEW	GM
1972 OLDSMOBILE DELTA 88 (CAR 403) WITH A 455-CID ENGINE AND EQUIPPED WITH A BASE-METAL OXIDATION CATALYST AND EGR							
Typical clear I, 35 percent aromatic (7202)	1	2.29	43.8	2.26	2.23	0.0516	0.0509
		3.08	43.6	2.02	2.04	.0463	.0468
		2.32	44.1	2.32	2.24	.0526	.0508
	Avg....	2.56	43.8	2.20	2.17	.0502	.0495
	2	0.57	38.1	2.24	1.79	0.0588	0.0470
		.69	41.0	2.27	1.94	.0554	.0473
		.67	33.2	2.45	2.10	.0738	.0632
	Avg....	.64	37.4	2.32	1.94	.0627	.0525
	3	1.19	42.2	1.93	1.75	0.0457	0.0415
		1.29	41.3	1.83	1.68	.0443	.0407
		1.12	42.2	2.06	1.82	.0488	.0431
	Avg....	1.20	41.9	1.94	1.75	.0463	.0418
Indolene clear, 22 percent aromatic (7203)	1	2.63	40.3	2.10	2.09	0.0521	0.0519
		4.13	42.3	1.85	1.89	.0437	.0447
		4.17	37.1	1.57	1.44	.0423	.0388
	Avg....	3.64	39.9	1.84	1.81	.0460	.0451
	2	0.72	37.7	2.24	1.88	0.0594	0.0499
		.70	35.9	2.36	1.99	.0657	.0554
		.71	34.4	2.24	1.83	.0651	.0532
	Avg....	.71	36.0	2.28	1.90	.0634	.0528
	3	1.83	41.0	1.82	1.73	0.0444	0.0422
		1.52	40.9	1.88	1.79	.0460	.0438
		1.59	40.6	1.85	1.76	.0456	.0433
	Avg....	1.65	40.8	1.85	1.76	.0453	.0431
1971 FORD LTD (CAR 810) WITH A 351-CID ENGINE AND EQUIPPED WITH ESSO RAM REACTORS AND EGR							
Typical clear I, 35 percent aromatic (7202)	1	1.69	38.6	1.48	1.58	0.0383	0.0409
		2.99	52.4	2.04	2.35	.0389	.0448
		2.15	49.9	1.78	2.11	.0357	.0423
	Avg....	2.28	50.0	1.77	2.01	.0376	.0427
	2	0.09	20.8	0.175	0.152	0.00841	0.00730
		.03	39.4	.699	.611	.0177	.0155
		.06	19.4	.144	.123	.00742	.00634
	Avg....	.06	26.5	.339	.295	.0112	.00971
	3	0.30	43.7	2.01	1.79	0.0460	0.0410
		.39	47.3	2.12	2.11	.0448	.0446
		.65	40.8	1.85	1.66	.0453	.0407
	Avg....	.45	43.9	1.99	1.85	.0453	.0421
Indolene clear, 22 percent aromatic (7203)	1	0.71	35.7	1.65	1.65	0.0462	0.0462
		1.48	49.5	1.69	2.23	.0341	.0450
		1.09	40.2	1.42	1.68	.0353	.0418
	Avg....	1.09	41.8	1.59	1.85	.0385	.0443
	2	0.08	69.6	2.43	2.29	0.0349	0.0329
		.09	36.5	1.03	1.27	.0282	.0348
		.04	51.6	2.15	1.75	.0417	.0339
	Avg....	.07	52.6	1.87	1.77	.0349	.0342
	3	0.34	40.5	2.07	1.90	0.0511	0.0469
		.53	40.5	2.12	2.22	.0523	.0548
		.46	41.6	1.84	1.88	.0442	.0452
	Avg....	.44	40.9	2.01	2.00	.0492	.0490

See footnotes at end of table.

TABLE D-1. - Exhaust hydrocarbon reactivity for individual bags of the 1975 Federal test procedure and individual replicate tests for prototype low emission systems 1/—Continued

Fuel	Bag number	Total HC, grams/test	Average molecular weight of HC	Hydrocarbon reactivity			
				Reactivity per mole of HC		Reactivity per gram of HC	
				HEW	GM	HEW	GM
1971 PLYMOUTH FURY III (CAR 333) WITH A 360-CID ENGINE AND EQUIPPED WITH PLATINUM OXIDATION CATALYSTS AND EGR							
Typical clear II, 40 percent aromatic (7221)	1	3.79	48.6	2.15	2.36	0.0442	0.0486
		3.12	44.4	1.92	1.32	.0432	.0297
		2.67	44.9	2.00	2.15	.0445	.0479
	Avg....	3.19	46.0	2.02	1.94	.0440	.0421
	2	1.12	33.5	1.35	1.30	0.0403	0.0388
		.92	30.0	1.06	1.04	.0353	.0347
		.86	30.0	1.07	1.04	.0357	.0347
	Avg....	.97	31.2	1.16	1.13	.0371	.0361
	3	1.22	37.2	1.58	1.52	0.0425	0.0409
		1.15	37.4	1.52	1.48	.0406	.0396
		1.10	35.8	1.46	1.45	.0408	.0405
	Avg....	1.16	36.8	1.52	1.48	.0413	.0403
Indolene clear, 22 percent aromatic (7203)	1	2.34	38.4	1.78	1.98	0.0464	0.0516
		2.04	35.7	1.67	1.79	.0468	.0501
		2.46	41.6	1.90	2.08	.0457	.0500
	Avg....	2.28	38.6	1.78	1.95	.0463	.0506
	2	0.97	30.2	1.23	1.30	0.0407	0.0430
		.90	28.5	.970	1.00	.0340	.0351
		.89	28.0	.930	.968	.0332	.0346
	Avg....	.92	28.9	1.04	1.09	.0360	.0376
	3	1.56	34.0	1.46	1.56	0.0429	0.0459
		1.50	33.2	1.44	1.50	.0434	.0452
		2.18	37.2	1.44	1.58	.0387	.0425
	Avg....	1.75	34.8	1.45	1.55	.0417	.0445
1972 FORD TORINO (CAR 724) WITH A 351-CID ENGINE AND EQUIPPED WITH PLATINUM OXIDATION CATALYSTS AND EGR							
Typical clear II, 40 percent aromatic (7221)	1	5.41	46.5	1.82	1.85	0.0391	0.0398
		4.50	45.3	1.80	1.81	.0397	.0400
		3.99	43.9	1.74	1.75	.0396	.0399
	Avg....	4.63	45.2	1.79	1.80	.0395	.0399
	2	1.52	37.0	1.24	1.21	0.0335	0.0327
		1.70	33.6	1.03	1.03	.0306	.0306
		1.19	32.6	.979	.962	.0300	.0295
	Avg....	1.47	34.4	1.08	1.07	.0314	.0309
	3	3.49	47.8	1.64	1.87	0.0343	0.0391
		2.90	46.7	1.53	1.74	.0328	.0372
		3.66	48.2	1.62	1.91	.0336	.0396
	Avg....	3.35	47.6	1.60	1.84	.0336	.0386
Indolene clear, 22 percent aromatic (7203)	1	4.55	37.9	1.50	1.65	0.0396	0.0435
		4.03	39.3	1.58	1.69	.0402	.0430
		3.76	39.2	1.44	1.57	.0367	.0400
	Avg....	4.11	38.8	1.51	1.64	.0388	.0422
	2	1.50	25.9	0.789	0.806	0.0305	0.0311
		1.64	32.9	1.10	1.25	.0334	.0380
		1.49	33.0	1.05	1.09	.0318	.0330
	Avg....	1.54	30.6	.980	1.05	.0319	.0340
	3	4.71	51.2	1.59	2.14	0.0310	0.0418
		4.73	50.0	1.52	2.06	.0304	.0412
		4.13	46.9	1.44	1.87	.0307	.0399
	Avg....	4.52	49.4	1.52	2.02	.0307	.0410

See footnotes at end of table.

TABLE D-1. - Exhaust hydrocarbon reactivity for individual bags of the 1975 Federal test procedure and individual replicate tests for prototype low emission systems 1/—Continued

Fuel	Bag number	Total HC, grams/test	Average molecular weight of HC	Hydrocarbon reactivity			
				Reactivity per mole of HC		Reactivity per gram of HC	
				HEW	GM	HEW	GM
1971 PLYMOUTH FURY III (CAR 775) WITH A 360-CID ENGINE AND EQUIPPED WITH THE ETHYL LEAN REACTORS AND EGR							
Typical clear II, 40 percent aromatic (7221)	1	4.11	44.2	2.19	2.15	0.0495	0.0495
		3.89	45.0	2.19	2.34	.0487	.0520
		5.64	49.5	2.11	2.30	.0426	.0465
	Avg....	4.55	46.2	2.16	2.26	.0469	.0493
	2	0.17	39.0	1.92	1.50	0.0492	0.0385
		.15	40.9	1.90	1.71	.0464	.0418
		.15	28.6	.989	.778	.0346	.0272
	Avg....	.16	36.2	1.60	1.33	.0434	.0358
	3	1.89	48.4	2.03	2.23	0.0419	0.0461
		2.16	56.2	2.15	2.55	.0382	.0454
		1.74	54.4	2.13	2.47	.0392	.0454
	Avg....	1.93	53.0	2.10	2.42	.0398	.0456
Indolene clear, 22 percent aromatic (7203)	1	2.79	39.8	2.32	2.40	0.0583	0.0603
		3.78	43.8	2.26	2.57	.0516	.0587
		3.84	44.3	2.29	2.59	.0517	.0585
	Avg....	3.47	42.6	2.29	2.52	.0539	.0592
	2	0.11	33.2	1.41	1.08	0.0425	0.0325
		.14	32.5	1.33	1.06	.0409	.0326
		.11	35.5	1.64	1.28	.0462	.0360
	Avg....	.12	33.7	1.46	1.14	.0432	.0337
	3	2.66	54.2	1.89	2.90	0.0349	0.0535
		3.29	58.4	2.21	3.17	.0378	.0543
		2.69	60.2	2.31	3.20	.0384	.0532
	Avg....	2.88	57.6	2.14	3.09	.0370	.0537
1970 CHEVROLET IMPALA (CAR 58) WITH A 350-CID ENGINE AND EQUIPPED WITH GEM MONEL NO_x REDUCTION CATALYSTS AND PLATINUM OXIDATION CATALYSTS							
Typical clear II, 40 percent aromatic (7221)	1	1.90	34.2	1.15	1.13	0.0336	0.0330
		3.11	41.0	1.50	1.54	.0366	.0376
		2.21	32.5	1.10	1.06	.0338	.0326
	Avg....	2.41	35.9	1.25	1.24	.0347	.0344
	2	0.69	25.2	0.555	0.608	0.0220	0.0241
		.57	27.4	.935	1.15	.0341	.0420
		.80	22.8	.452	.627	.0198	.0275
	Avg....	.69	25.1	.647	.795	.0253	.0312
	3	0.89	27.6	0.531	0.536	0.0192	0.0194
		.84	28.2	.577	.576	.0205	.0204
		1.00	28.6	.572	.562	.0200	.0196
	Avg....	.91	28.1	.560	.558	.0199	.0198
Indolene clear, 22 percent aromatic (7203)	1	2.34	-	-	-	-	-
		3.29	34.2	1.23	1.31	0.0360	0.0383
		2.40	31.0	1.16	1.18	.0374	.0381
	Avg....	2.68	32.6	1.20	1.24	.0367	.0382
	2	0.83	-	-	-	-	-
		.77	21.6	0.442	0.438	0.0205	0.0203
		.94	22.2	.388	.392	.0175	.0176
	Avg....	.85	21.9	.415	.415	.0190	.0190
	3	1.03	-	-	-	-	-
		1.02	25.8	0.420	0.467	0.0163	0.0181
		.94	24.8	.421	.441	.0170	.0178
	Avg....	1.00	25.3	.420	.454	.0166	.0180

1/All tests were conducted at 75° F ambient temperature.

TABLE D-2. - Exhaust hydrocarbon reactivity for individual replicate tests weighted in accordance with 1975 Federal test procedure for prototype low emission systems 1/

Fuel	Total HC, grams/mile	Average molecular weight of HC	Hydrocarbon reactivity: Reactivity per mole of HC		Hydrocarbon reactivity: Reactivity per gram of HC	
			HEW	GM	HEW	GM
1972 OLDSMOBILE DELTA 88 (CAR 403) WITH A 455-CID ENGINE AND EQUIPPED WITH A BASE-METAL OXIDATION CATALYST AND EGR						
Typical clear I, 35 percent aromatic (7202)	0.30	41.7	2.16	1.96	0.0518	0.0470
	.37	42.3	2.03	1.91	.0480	.0452
	.31	39.8	2.30	2.08	.0578	.0523
Avg....	.33	41.3	2.16	1.98	.0525	.0482
Indolene clear, 22 percent aromatic (7203)	0.39	39.7	2.06	1.92	0.0519	0.0484
	.45	40.4	1.98	1.89	.0490	.0468
	.45	37.3	1.79	1.61	.0480	.0432
Avg....	.43	39.1	1.94	1.81	.0496	.0461
1971 FORD LTD (CAR 810) WITH A 351-CID ENGINE AND EQUIPPED WITH ESSO RAM REACTORS AND EGR						
Typical clear I, 35 percent aromatic (7202)	0.13	36.5	1.35	1.38	0.0370	0.0378
	.21	51.2	.443	2.24	.00865	.0438
	.18	44.1	1.64	1.78	.0372	.0404
Avg....	.17	43.9	1.14	1.80	.0276	.0407
Indolene clear, 22 percent aromatic (7203)	0.08	40.0	1.85	1.78	0.0462	0.0445
	.14	45.1	1.75	2.12	.0388	.0470
	.10	41.2	1.59	1.76	.0386	.0427
Avg....	.11	42.1	1.73	1.89	.0412	.0447
1971 PLYMOUTH FURY III (CAR 333) WITH A 360-CID ENGINE AND EQUIPPED WITH PLATINUM OXIDATION CATALYSTS AND EGR						
Typical clear II, 40 percent aromatic (7221)	0.46	40.2	1.71	1.78	0.0425	0.0443
	.39	37.2	1.49	1.25	.0400	.0336
	.35	36.7	1.49	1.53	.0406	.0417
Avg....	.40	38.0	1.56	1.52	.0410	.0399
Indolene clear, 22 percent aromatic (7203)	0.38	33.9	1.47	1.59	0.0434	0.0469
	.35	32.2	1.33	1.39	.0413	.0432
	.43	35.2	1.39	1.51	.0395	.0429
Avg....	.39	33.8	1.40	1.50	.0414	.0443
1972 FORD TORINO (CAR 724) WITH A 351-CID ENGINE AND EQUIPPED WITH PLATINUM OXIDATION CATALYSTS AND EGR						
Typical clear II, 40 percent aromatic (7221)	0.78	44.0	1.59	1.66	0.0361	0.0377
	.70	41.1	1.42	1.48	.0345	.0360
	.67	42.0	1.46	1.57	.0348	.0374
Avg....	.72	42.4	1.49	1.57	.0351	.0370
Indolene clear, 22 percent aromatic (7203)	0.82	38.0	1.27	1.51	0.0334	0.0397
	.81	41.0	1.40	1.68	.0341	.0410
	.73	40.0	1.31	1.52	.0327	.0380
Avg....	.79	39.7	1.33	1.57	.0334	.0396
1971 PLYMOUTH FURY III (CAR 775) WITH A 360-CID ENGINE AND EQUIPPED WITH THE ETHYL LEAN REACTORS AND EGR						
Typical clear II, 40 percent aromatic (7221)	0.40	45.2	2.12	2.13	0.0469	0.0471
	.41	48.7	2.16	2.37	.0443	.0487
	.48	49.2	2.03	2.23	.0413	.0453
Avg....	.43	47.7	2.10	2.24	.0442	.0470
Indolene clear, 22 percent aromatic (7203)	0.38	46.0	2.07	2.56	0.0450	0.0556
	.49	49.6	2.18	2.75	.0440	.0554
	.44	50.1	2.27	2.77	.0453	.0553
Avg....	.44	48.6	2.17	2.69	.0448	.0554
1970 CHEVROLET IMPALA (CAR 58) WITH A 350-CID ENGINE AND EQUIPPED WITH GEM MONEL NO_x REDUCTION CATALYSTS AND PLATINUM OXIDATION CATALYSTS						
Typical clear II, 40 percent aromatic (7221)	0.27	29.0	0.754	0.768	0.0260	0.0265
	.32	33.9	1.11	1.19	.0327	.0351
	.31	27.5	.706	.761	.0257	.0277
Avg....	.30	30.1	.857	.906	.0281	.0298
Indolene clear, 22 percent aromatic (7203)	0.32	-	-	-	-	-
	.37	27.8	0.765	0.806	0.0275	0.0290
	.34	25.8	.659	.671	.0255	.0260
Avg....	.34	26.8	.712	.738	.0265	.0275

1/All tests were conducted at 75° F ambient temperature.

APPENDIX E -- DATA ON COMPARISON OF MBTH AND DNPH METHODS FOR ALDEHYDE MEASUREMENTS
(DATA ARE EXPRESSED AS GRAMS/MILE ON THE BASIS OF THE
1972 FEDERAL TEST PROCEDURE) 1/

Fuel	MBTH	DNPH	MBTH	DNPH
	1972 OLDS 98 (CAR 151) - 455 CID		1970 VOLKSWAGON (CAR 365) - 1,600 CC	
Typical clear II, 40 percent aromatic (7221)	0.14	0.17	0.070	0.10
	.11	.16	.064	.12
	.14	.18	.080	.14
Avg.....	.13	.17	.071	.12
Indolene clear, 22 percent aromatic (7203)	0.12	0.18	0.086	0.091
	.12	.17	.077	.102
Avg.....	.12	.18	.082	.096
	1971 FORD GALAXIE (CAR 707) - 351 CID		1971 PLYMOUTH FURY III (CAR 76) - 360 CID	
Typical clear II, 40 percent aromatic (7221)	0.16	0.21	0.20	0.22
	.13	.20	.15	.23
Avg.....	.14	.20	.18	.22
Indolene clear, 22 percent aromatic (7203)	0.16	0.14	0.12	0.19
	.17	.20	.16	.18
Avg.....	.16	.17	.14	.18
	1972 FORD TORINO (CAR 769) - 351 CID		1971 CHEVROLET IMPALA (CAR 595) - 350 CID	
Typical clear II, 40 percent aromatic (7221)	0.085	0.096	0.15	0.17
	.079	.12	.14	.16
Avg.....	.082	.11	.14	.16
Indolene clear, 22 percent aromatic (7203)	0.082	0.10	0.13	0.16
	.082	.098	.13	.14
Avg.....	.082	.10	.13	.15
	1970 PONTIAC (CAR 400) - 400 CID		1971 CHEVROLET VEGA (CAR 68) - 2,300 CC	
Typical clear II, 40 percent aromatic (7221)	0.27	0.36	0.083	0.087
	.21	.40	.083	.11
Avg.....	.24	.38	.083	.098
Indolene clear, 22 percent aromatic (7203)	0.25	0.34	0.085	0.12
	.28	.32	.11	.12
Avg.....	.26	.33	.098	.12
	1973 FORD TORINO (CAR 146) - 351 CID		1973 CHEVROLET IMPALA (CAR 110) - 350 CID	
Typical clear II, 40 percent aromatic (7221)	0.16	0.17	0.23	0.34
	.15	.18	.18	.23
Avg.....	.16	.18	.20	.28
Indolene clear, 22 percent aromatic (7203)	0.14	0.18	0.18	0.26
	.16	.19	.19	.21
Avg.....	.15	.18	.18	.24

1/ All tests were conducted at 75° F ambient temperature. Data include all replicate tests.